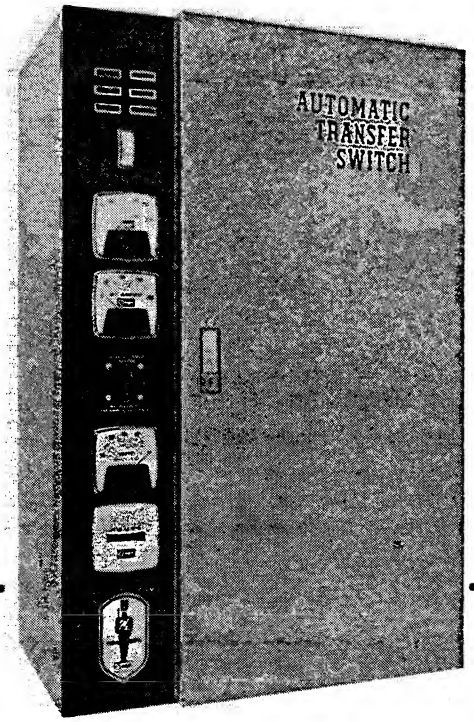
McGRAW-EDISON

Onan

Operators Manual

AT
Switch



30 through 400 Amperes

962-0100
SPEC A-C
3-82
Printed in U.S.A.

Safety Precautions

This manual includes the following symbols to indicate potentially dangerous conditions to the operator or equipment. Read the manual carefully and know when these conditions exist. Then take the necessary steps to protect personnel and the equipment.

WARNING ***This symbol is used throughout this manual to warn of possible serious personal injury.***

CAUTION ***This symbol refers to possible equipment damage.***

The automatic transfer switch has components with high voltages which present serious shock hazards. For this reason, read the following suggestions:

Keep the automatic transfer switch cabinet(s) closed and locked. Make sure only authorized personnel have the cabinet keys.

Always move the operation selector switch on the generator set or automatic transfer switch to *STOP*, disconnect the starting batteries of the generator set, and remove AC line power to the automatic transfer switch before performing maintenance or adjustments (unless specified otherwise in the instructions—then only using extreme caution due to danger of shock hazard).

Before using the disconnect plug, if equipped, for de-energizing the control panel, be sure to place the operation selector switch on the generator set or automatic transfer switch to the *STOP* position. Neglect of this procedure results in set starting and energization of the transfer switch generator side.

Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when working on any electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on the electrical equipment.

Do not work on this equipment when mentally or physically fatigued.

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC–rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work–harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.
- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [–] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [–] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

Table of Contents

General Information

INTRODUCTION

This operator's manual provides the information necessary for the successful operation of Onan's series AT transfer switches. The manual includes installation, description, operation, and adjustment chapters. A troubleshooting guide and service information are also included. Operators should become familiar with this manual and especially the operation procedures that apply to their Series AT transfer switch.

TRANSFER SWITCH APPLICATION

Transfer switches are an essential part of a building's standby or emergency power system. The normal power source, commonly the utility line, is backed up by an emergency power source, often an electric generating set. A transfer switch supplies the electrical load with power from one of these two power sources. The load being served is connected to the common of the transfer switch as in Figure 1. Under normal conditions the load is supplied with power from the normal source as illustrated. Should the normal power source be interrupted, the load is transferred to the emergency power source. When normal power returns, the load is retransferred to the normal power source. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

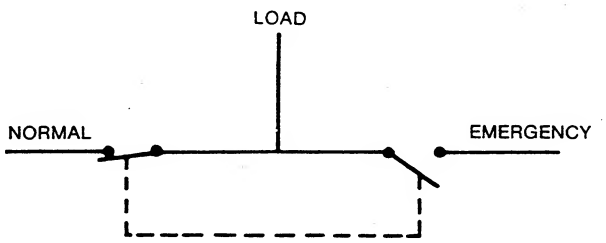


FIGURE 1. TRANSFER SWITCH

AUTOMATIC TRANSFER SWITCHES

Automatic transfer switches are capable of operation without operator involvement. During automatic operation, an automatic transfer switch performs the following basic functions.

1. Senses the interruption of the normal power source
2. Sends a start signal to the electric generating set
3. Transfers the load to the emergency power source
4. Senses the return of the normal power source
5. Retransfers the load to the normal power source
6. Sends a stop signal to the electric generating set

Installation

LOCATION

Locating the automatic transfer switch in the existing circuit varies with application and type of entrance switch. There must be a switch and fuses in commercial power line before the automatic transfer switch. See the typical installation in Figure 2.

MOUNTING

If the AT automatic transfer switch cabinet is an enclosed cabinet (as shown in Figure 2), use the following mounting instructions given under *Enclosed-Cabinet AT.* If the automatic transfer switch is a chassis mount type (transfer switch mounted on panel with control), use the mounting instructions given under *Open-Construction AT.*

Enclosed-Cabinet AT

1. Choose a mounting surface on a vibration-free wall for convenient mounting and wiring of the automatic transfer switch. See Figure 2. Avoid hot, moist or dusty locations.
2. Install the two top mounting bolts in the wall.
3. Open automatic transfer switch cabinet door.
4. Remove twist-lock disconnect plug from receptacle.
5. Remove the shipping screws which hold the swinging control panel closed and discard them. Then pull open the control panel.
6. ***30 thru 225 Ampere AT:*** Remove the one screw on top and one screw on bottom from inside meter panel flange. Swing meter panel open.

   400 Ampere AT (two cabinet doors): Remove one screw from inside center support for left door. Open door and remove two screws, one on top and one on bottom, from inside meter panel flange. Open meter panel and door to fully open position.
7. Raise cabinet and mount on the two mounting bolts in wall (top holes are keyholes).

   WARNING ***Lifting the cabinet could cause serious personal injury. Be sure to have sufficient manpower for lifting the cabinet to prevent personal injury.***
8. Tighten the top mounting bolts.
9. Install the bottom two mounting bolts and tighten.

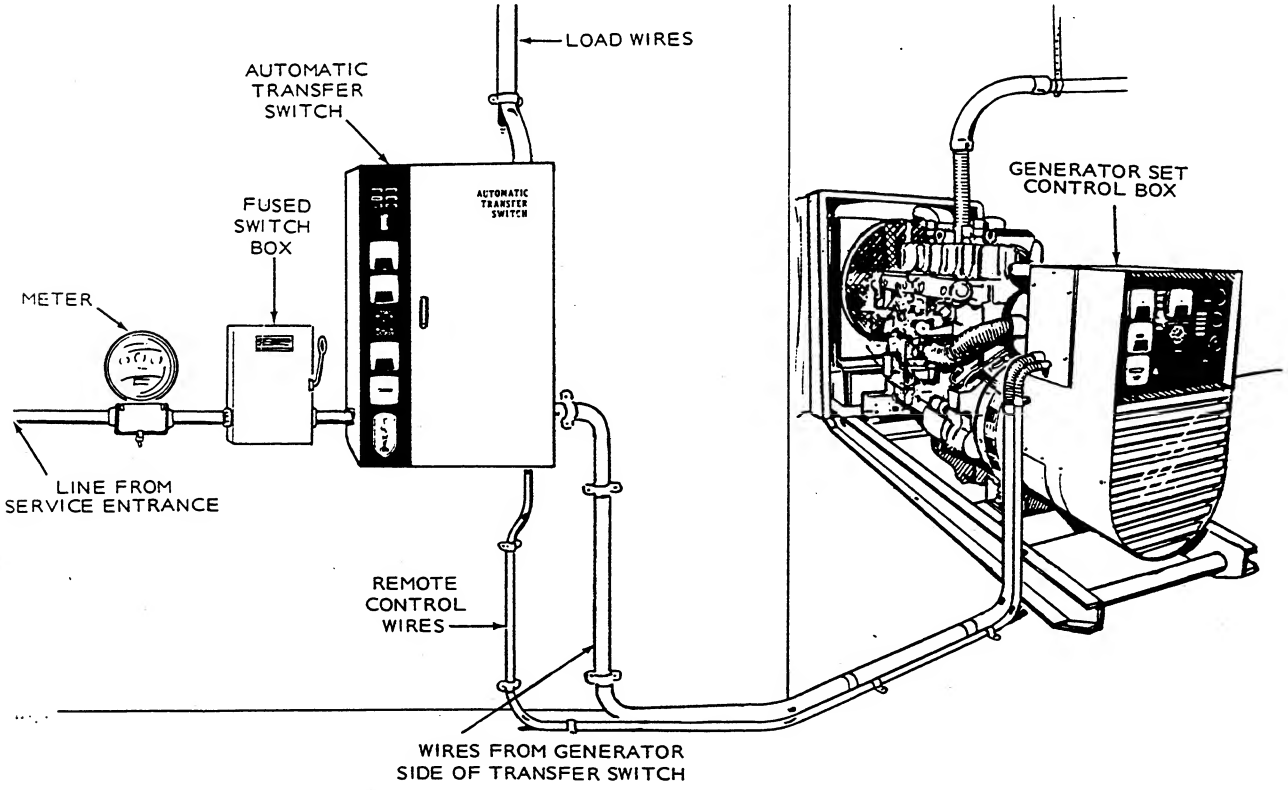


FIGURE 2. TYPICAL AUTOMATIC TRANSFER SWITCH INSTALLATION

10. Vacuum the interior of the cabinet to remove all dust, chips and filings.

Open-Construction AT

Whether the open-construction AT is wall mounted or mounted in a customer-furnished cubicle, choose a mounting surface on a vibration-free wall for convenient mounting and wiring.

Wall Mounted (no cubicle used):

1. Six 0.50-inch (13-mm) diameter mounting holes are furnished in the metal panel of the open-construction AT.
2. Raise the panel and mount using six 3/8-inch mounting bolts, lockwashers and nuts.

   WARNING ***Lifting the cabinet could cause serious personal injury. Be sure to have sufficient manpower for lifting the cabinet to prevent personal injury.***

3. Vacuum off the transfer switch and interior of the control cabinet to remove all dust, chips and filings.

Mounted in Customer-Furnished Cubicle:

1. Six 0.50-inch (13-mm) diameter mounting holes are furnished in the metal panel of the open-construction AT. Locate and drill 0.50-inch (13-mm) diameter holes in the rear of the cabinet to match holes of AT panel.
2. Furnished cubicle must be at least 13 inches (330 mm) deep to accommodate AT panel. Raise the AT panel into the cubicle, and secure with six 3/8-inch screws, lockwashers and nuts.

   WARNING ***Lifting the cabinet could cause serious personal injury. Be sure to have sufficient manpower for lifting the cabinet to prevent personal injury.***

3. Locate and drill mounting holes on the wall for the cubicle.
4. Raise and mount the cubicle on the wall.

   WARNING ***Lifting the cabinet could cause serious personal injury. Be sure to have sufficient manpower for lifting the cabinet to prevent personal injury.***

5. Vacuum the interior of the cabinet to remove all dust, chips and filings.

TABLE 1. AUTOMATIC TRANSFER SWITCH WIRE CAPACITIES

AUTOMATIC TRANSFER SWITCH (AMPERES)		30	60	100	225	400
TERMINAL LUGS Number of Conductors and Size per Pole	Switch Pole*	ONE 14-6	ONE 14-1/0	ONE 14-1/0	ONE 6-350MCM	ONE 350MCM-1000MCM
	Neutral Bar*	ONE 14-2	ONE 14-2	ONE 14-1/0	ONE 6-350MCM	ONE 350MCM-1000MCM

* - Connectors compatible with copper and aluminum.

WIRING

Onan suggests to the qualified personnel that the wiring be performed in the suggested sequence:

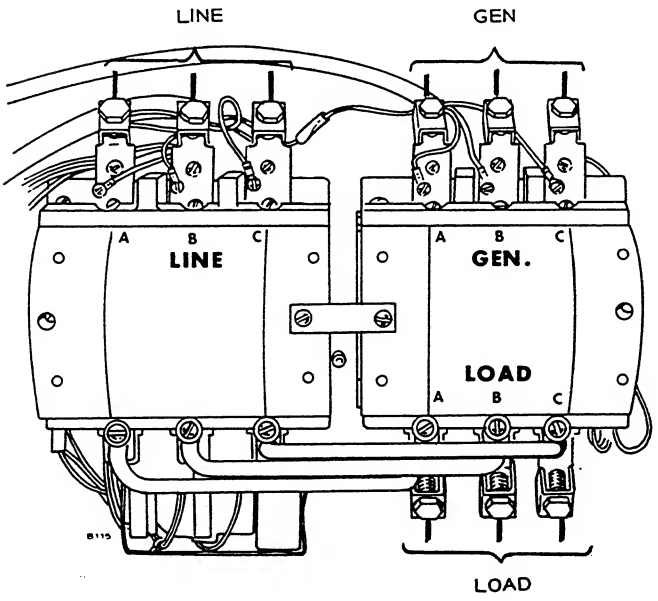
1. Before wiring is started, test the operation of the generator set from its controls.
2. Put the generator set control switch at *STOP* and remove the negative lead from the cranking battery.

WARNING ***Failure to prevent the generator set from starting before wiring procedures are performed presents a shock hazard and might cause serious personal injury or death.***

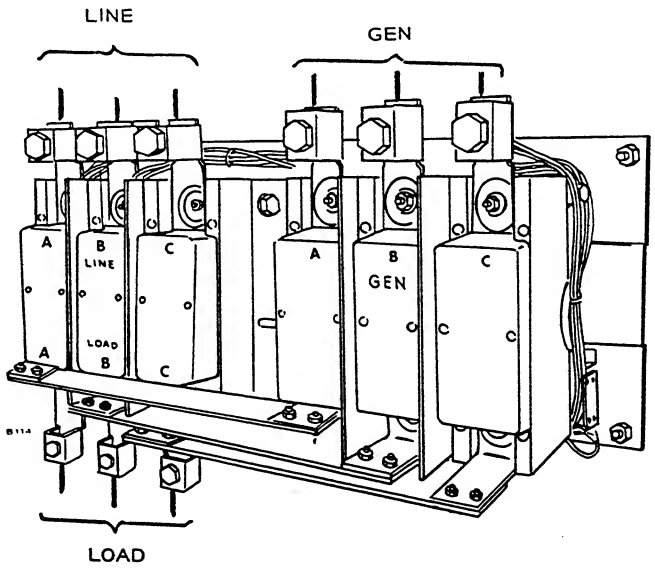
3. Connect wires of sufficient size to carry rated current from the line, load, and generator set directly to the transfer switch terminals which are marked A, B, and C (A and B on single-phase switches). Table 1 gives the type and maximum wire size the transfer switch will accept. Load wires connect to the right bottom side of 30 through 225 ampere transfer switches, to the left bottom side of the 400 ampere transfer switches. See Figure 3.

At the same time the wires are connected to the transfer switch, remove the shipping block on the transfer switch. On the 30- through 100-ampere switches, the blocks consist of 2 clips on the side of the transfer switch. After removal of the clips for the 30-ampere transfer switch, re-install the capscrews.

30 THROUGH 225 AMPERE
TRANSFER SWITCH CONNECTIONS



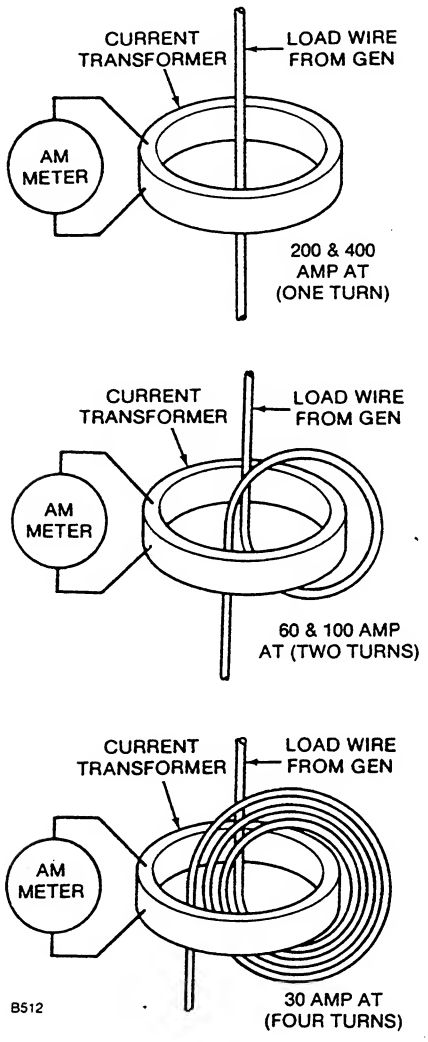
400 AMPERE
TRANSFER SWITCH CONNECTIONS



NOTE: CONNECTIONS SHOWN ARE FOR THREE PHASE.

FIGURE 3. TRANSFER SWITCH WIRE CONNECTIONS

4. ***Ammeter Readings:*** To obtain accurate ammeter readings it is necessary that the *GEN LOAD* wire pass through the current transformer a specified number of turns. The *GEN LOAD* wire initially passes through the current transformer. Figure 4 illustrates the appropriate number of turns the *GEN LOAD* wire completes.



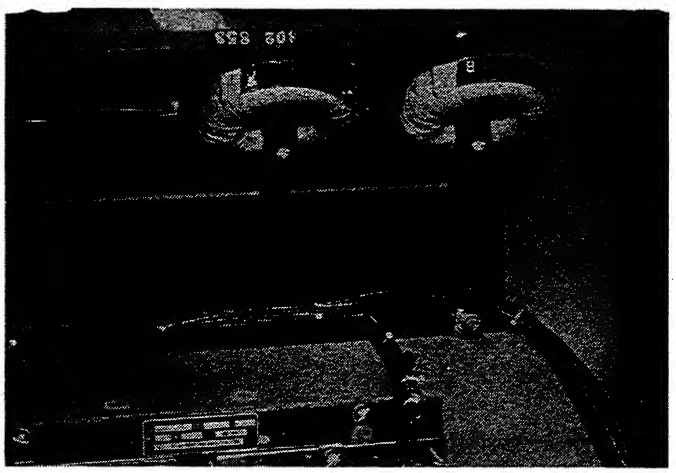


FIGURE 4. CURRENT TRANSFORMER

5. ***Neutral Bar Installation (if used):***
   A. Hold the neutral bar in one hand, then remove the nuts and washers from the mounting bolts.
   B. Hold the insulators so they will not fall off the neutral bar and remove the mounting bolts.
   C. Mount the neutral bar to the bottom of the automatic transfer switch cabinet (Figure 5). Table 1 gives the wire size and type the neutral bar will accept.

The neutral bar on open-construction AT automatic transfer switches mounts on channel bracket just below the transfer switch.

6. ***Low Voltage DC Control Wires:*** Connect the DC control wires from the automatic transfer switch terminal block TB1 to the generator set (Figure 6). AT-C and AT-D models use three terminals, B+, ground (GND) and remote (RMT). AT-E models use four terminals, B+, 1, 2, and 3. Use number 16 wire up to 100 feet or 31 metres (maximum of 0.5 ohm per line).

TB1 of open-construction AT models is located on inside, lower left panel of the control cabinet.

When using conduit, run all low voltage DC control wires in a separate conduit from AC wires. Use a flexible conduit between generator set and automatic transfer switch to prevent transmission of vibration. See Figure 1.

If conduit is not used, a ground wire must interconnect the generator set, automatic transfer switch, switch and fuse boxes to the main entrance ground.

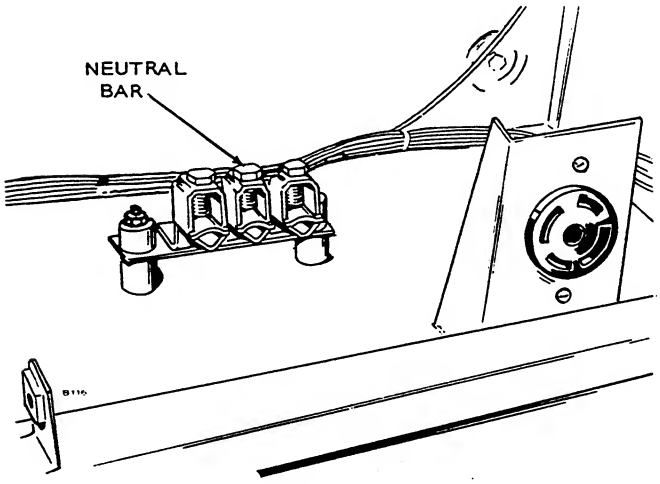


FIGURE 5. INSTALLATION OF NEUTRAL BAR

7. ***Area Protection or Remote Test Switch (if used):***
   A. Remove terminal jumper located between terminals 4 and 5 of terminal strip TB1 (Figure 6).

TB1 of open-construction AT models is located on inside, lower left panel of the control cabinet.

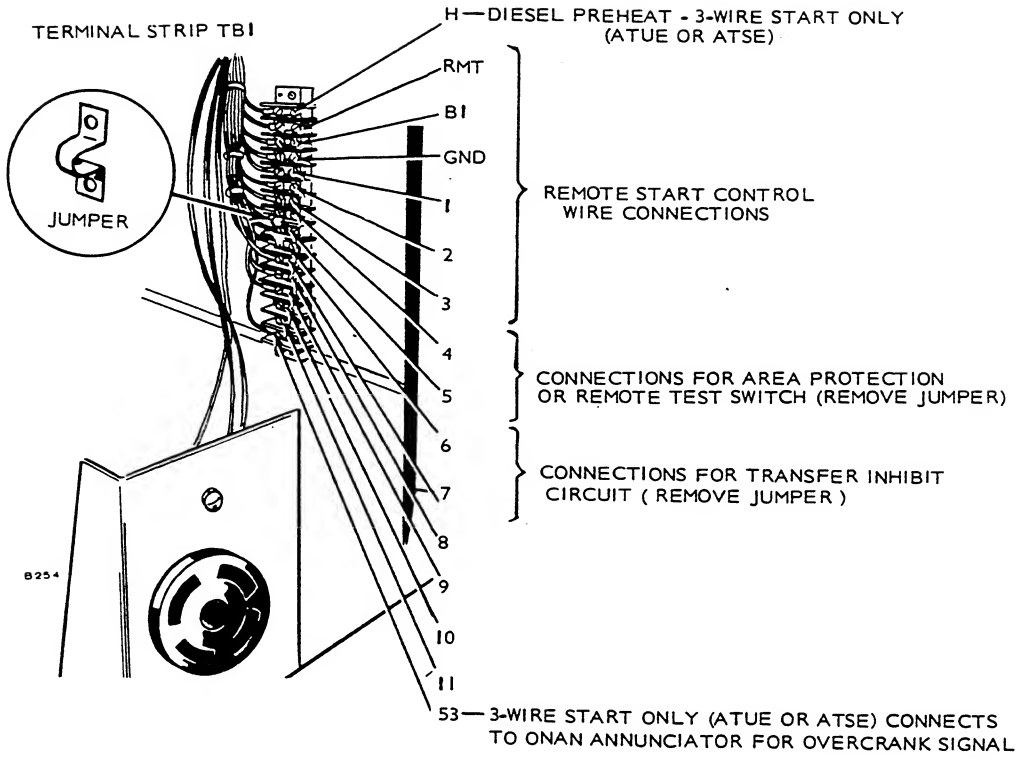


FIGURE 6. CABINET TERMINAL BLOCK TB1 (SPEC B SHOWN)

B. Connect the two leads from the normally closed circuit of area protection equipment or single-pole, single-throw remote test switch to terminals TB1-4 and TB1-5. Use number 16 wire up to 800 feet or 244 metres (maximum resistance of 4 ohms per line).

8. ***Diesel Preheat Time Delay (if used):*** If this delay is used for operation of glow plugs on three-wire start generator sets, connect a wire from terminal TB1-H in the automatic transfer switch (*ATUE* or *ATSE* only) to terminal *H* on the generator set. TB1 of an open-construction AT is located on inside, lower left panel of the control cabinet. Use number 16 wire for distances up to 100 feet or 31 metres (maximum of 0.5 ohm per line). See Figure 6.

9. ***Onan Annunciator Connection for Overcrank (if used):*** Connect a wire from terminal TB1-53 in the automatic transfer switch (*AT-E* only) to terminal 53 on the Onan annunciator panel (Figure 6). TB1 of an open-construction AT is located on inside, lower left panel of the control cabinet. Use number 16 wire for distances up to 800 feet or 244 metres (maximum of 4 ohms per line).

The AT-E automatic transfer switch supplying the start-stop signals must use the 2 to 3 wire converter.

10. ***Transfer Inhibit Circuit.*** To inhibit transfer of the automatic transfer switch by another automatic transfer switch (for paralleling systems, priority selection systems, etc.), remove the jumper between TB1-6 and TB1-7. Connect the wire leads from the external equipment to these two terminals. See Figure 6.

11. ***Battery Voltage Alarm Circuit (if equipped):*** For automatic transfer switches with a high battery voltage *(HI BAT VOLT)* and low battery voltage *(LO BAT VOLT)* lamp on the meter-lamp panel, there is a six-place terminal block TB2 for external circuit connections. The terminal block is located just above the TB1 terminal block used for remote connections (Figure 7). Connect the wire leads from an external signal or alarm to terminal block TB2 as follows:

A. High battery voltage alarm—normally open contacts connect to terminals 1 and 2, normally closed contacts connect to terminals 2 and 3.

B. Low battery voltage alarm—normally open contacts connect to terminals 4 and 5. Normally closed contacts connect to terminals 5 and 6.

12. ***Auxiliary Contacts (if equipped):*** For a transfer switch with auxiliary contacts on line and generator side, there is a six-place terminal block TB9 for the external alarms or control circuitry. TB9 is located above terminal block TB1 for remote connections and TB2 for the battery voltage sensor connections (Figure 7), if used (TB9 located on rear panel of control cabinet for open-construction models). Ratings for the contacts are 6 amperes at 120 volts, 3 amperes at 240 volts, and 1-1/2 amperes at 600 volts.

    A. Line side—normally open contacts connect to terminals 1 and 2; normally closed contacts to terminals 2 and 3.
    B. Generator side—normally open contacts connect to terminals 4 and 5; normally closed contacts to terminals 5 and 6.

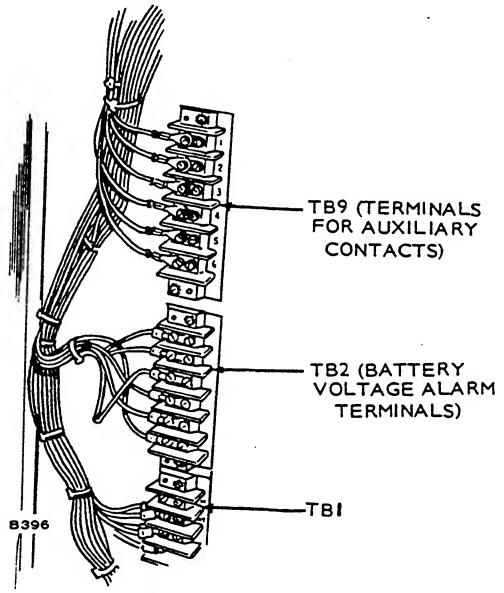


FIGURE 7. LOCATION OF TERMINAL BLOCKS TB2 AND TB9

13. ***Three-Phase Only:*** Phase rotation must be checked and corrected before any load can be added to the generator set. Use the following procedures:

    A. Connect an Onan load-test panel, phase rotation meter or three-phase motor to the transfer switch load terminals. Connect power to the line side (normal) of the transfer switch and observe rotation. If rotation is wrong, reverse any two main phase leads on the line side of the transfer switch.
    B. Connect the battery and start the generator set. Check the phase rotation of the generator lead connections on the transfer switch. If this phase rotation is different from that of the power line, reverse two of the generator leads on the transfer switch.

CHECKOUT PROCEDURES AFTER INSTALLATION

After the generator set and automatic transfer switch are properly installed, check the various automatic transfer switch functions. Follow the appropriate checkout procedure for the automatic transfer switch, depending on whether it has a control accessory panel in groups 10 through 15 and 20 through 25 (has solid-state, plug-in modules) or in groups 51 through 55 (relay groups).

If the control accessory panel does not close properly because the latch is above or below the latch pin, adjust the latch mechanism as described in the *ADJUSTMENTS* section.

AT's With Solid State Module Control Accessory Groups (10-15 and 20-25)

Check Switch Positions:

1. Operation Selector Switch.

   For an AT-C or AT-D automatic transfer switch, move the operation selector switch on the generator set to *STOP*. For AT-E automatic transfer switches, move the 2 to 3 wire converter module 9 operation selector switch to *STOP*.
2. Move selector switch to *WITHOUT LOAD*.
3. Move test transfer switch to *NORMAL*.

Connect AC Line: Connect the AC normal line service to the automatic transfer switch. The transfer switch should transfer the load to the line and should light the green *NORMAL* lamp (if equipped with lamps).

Connect the Battery: Charge ammeter should now indicate a charging current (if equipped with battery charger).

Test Overcrank Function:

1. AT-C and AT-D (two-wire start).
    A. Disconnect the positive lead from the starter (insulate lead so it can not touch metal frame).
    B. Move the operation selector switch on the engine control to *RMT*.
    C. Move the test transfer switch to *TEST*. The fault or overcrank lamp on engine control should light at the end of crank period (usually factory set at 75, ± 10 seconds).
    D. Move test transfer switch to *NORMAL*.
    E. Move the generator set operation selector switch to *STOP*.
    F. Reconnect positive lead to starter.
    G. Move generator set operation selector switch to *RMT*.

2. AT-E only (three-wire start).
   A. Disconnect positive start lead from the start solenoid or starter.
   B. Move 2 to 3 wire converter selector switch to *NORMAL*.
   C. Move test transfer switch to *TEST*. Overcrank lamp on automatic transfer switch should light at end of crank period (usually factory set at 75, ± 10 seconds).
   D. Move test transfer switch to *NORMAL*.
   E. Move 2 to 3 wire converter selector switch to *STOP* and push the *PUSH TO RESET* button (overcrank lamp should go out).
   F. Reconnect positive lead to starter or start solenoid.
   G. Move 2 to 3 wire convertor selector switch to *NORMAL*.

Starting Test:

1. AT-C and AT-D (two-wire start).
   A. Move selector switch on engine control to *RUN*. Generator set should start and run.
   B. Move selector switch to *RMT*. Generator set should stop.

2. AT-E only (three-wire start).
   A. Move selector switch on 2 to 3 wire converter to *HAND CRANK*.
   B. Push start button on generator set control. Generator set should start and run.
   C. Move selector switch from *HAND CRANK* to *STOP*. Generator set should stop.
   D. Move selector switch to *NORMAL*. Generator set should not start.

Test Transfer Without Load:

1. Make sure selector switch is positioned to *WITHOUT LOAD*.
2. Move test transfer switch to *TEST*. Generator set should start and run.
3. Move test transfer switch to *NORMAL*. Generator set should stop.

Exercise Without Load (if equipped with exerciser):

1. Make sure selector switch is positioned at *WITHOUT LOAD*.
2. Align day for exercise on spoked wheel with day pointer.
3. Turn the 24-hour dial clockwise until the pointer is between the two pins. The generator set should start and run, but not assume the load.
4. Turn the dial clockwise until the outside pin passes the pointer. Generator set should stop.
5. Reset the exerciser for the correct time and day.

Test Transfer With Load:

1. Move selector switch to *WITH LOAD*.
2. Move test transfer switch to *TEST*. Generator set should start after start time delay, take over the load and light the red "emergency" lamp (if equipped with lamps).
3. Check operation of the AC meter(s) on the meter-lamp panel (if equipped with meters).
4. Move the test transfer switch to *NORMAL*. Transfer switch should retransfer the load to line and stop engine after duration of time delays.

Battery Voltage Lamps (if equipped):

1. Remove the battery charger module 6. Low battery voltage lamp *(LO BAT VOLT)* should light within 60 seconds.

   The transfer switch line terminals must be energized and the battery must be connected to the automatic transfer switch.

2. Replace battery charger module 6. Low battery voltage lamp should go out within 60 seconds.

AT's With Relay-Type Control Accessory Groups (51 Through 55)

Check Switch Positions:

1. Operation Selector Switch (AT-C and AT-D only): Move the operation selector switch on the generator set engine control to *STOP*.
2. Move selector switch S2 on the control accessory panel to *NORMAL*.
3. Move test transfer switch S1 to *NORMAL*.

Connect AC Line: Connect the AC normal line to the automatic transfer switch. The transfer switch should transfer the load to the line and light the green *NORMAL* lamp (if equipped with lamps).

Connect the Battery: Connect the starting battery to the generator set observing correct polarity.

Test Overcrank Function:

1. AT-C and AT-D (two-wire start)
   A. Disconnect the positive lead from the starter (insulate lead so it cannot touch metal frame).
   B. Move the operation selector switch on the engine control to *RMT*.
   C. Move the test transfer switch to *TEST*. Fault or overcrank lamp on engine control should light at end of crank period (usually factory set at 75, ±10 seconds).
   D. Move test transfer switch to *NORMAL*.

E. Move the operation selector switch on engine control to *STOP*.

F. Reconnect the positive lead to starter.

G. Move operation selector switch on engine control to *RMT*.

2. AT-E Only (three-wire start)

A. Disconnect positive start lead from the starter or start solenoid (insulate lead so it cannot touch metal frame).

B. Move operation selector switch on control accessory panel to *NORMAL*.

C. Move test transfer switch to *TEST*. Overcrank lamp on automatic transfer switch should light at end of crank period (approximately 45 to 90 seconds).

D. Move operation selector switch to *STOP*.

E. After about one minute, press the reset button on the cranking limiter. The overcrank lamp should go out.

F. Reconnect the positive lead to the starter or start solenoid.

G. Move operation selector switch on control accessory panel to *NORMAL*.

Starting Test:

1. AT-C and AT-D (two-wire start)

A. Move the operation selector switch on the engine control to *RUN*. Generator set should start and run.

B. Move the operation selector switch to *RMT*. Generator set should stop.

2. AT-E Only (three-wire start)

A. Move operation selector switch on control accessory panel to *OFF*.

B. Push start button on generator set control. Generator set should start and run.

C. Push stop switch on generator set control. Generator set should stop.

D. Move operation selector switch on control accessory panel to *NORMAL*.

Test Transfer Without Load:

1. Move operation selector switch to *TEST*. Generator set should start and run.
2. Move operation selector switch back to *NORMAL*. Generator set should stop.

Exercise Without Load (if equipped with exerciser):

1. Align day for exercise on spoked wheel with day pointer.
2. Turn the 24-hour dial clockwise until the pointer is between the two pins. The generator set shoud start and run, but not assume the load.
3. Turn the dial clockwise until the outside pin passes the pointer. The generator set should stop.
4. Reset the exerciser for the correct time and day (see *ADJUSTMENTS* section).

Test Transfer With Load:

1. Move test transfer switch to *TEST*. The generator set should start (after start time delay if used), run, take over the load, and light the red emergency lamp on the meter-lamp panel (if equipped with normal and emergency lamps).
2. Check operation of AC meter(s) on meter-lamp panel (if equipped with meters).
3. Move the test transfer switch to *NORMAL*. The transfer switch should retransfer the load to the normal line and stop the generator set (after duration of time delays if used).

Description

TRANSFER SWITCH

The transfer switch does the actual transferring of the load to normal line power or standby generator set. Transfer switches have operating coils, power contacts and auxiliary contacts. A mechanical interlock in the transfer switch prevents line and generator contacts from closing at the same time. Current ratings of the transfer switches determine the current ratings of the automatic transfer switches.

Transfer Switch Manual Operator (See B and C Only)

Included with all mechanically-held transfer switches (line and generator side), the operator can manually open or close the transfer switch on line or generator side.

Auxiliary Contacts

These contacts are used on line or generator side, or both sides of the transfer switch for a pilot, signal or other special application circuit. They do not operate while the generator set is exercising unless it takes over the load (transfer switch operates). Ratings for the contacts are 6 amperes at 120 volts, 3 amperes at 240 volts, and 1-1/2 amperes at 600 volts.

Programmed Transition

Adjustable from 1 to 300 seconds, the programmed transition assembly delays transfer of the load to the generator and retransfer of the load back to normal line. Used with motor loads, it breaks power to the motor loads long enough, usually a few seconds, during transfer switch operation to permit motor residual voltages to decay before load connection to either normal line or the generator set. This avoids nuisance trips of overcurrent protection equipment, prevents damaged motors, couplings, or driven loads.

METER-LAMP PANEL

The meter-lamp panel on the left of the automatic transfer switch holds the combination of meters, selector switches, indicating lamps and step-down transformers that was specified for your automatic transfer switch. The meter-lamp combination of your automatic transfer switch determines which of these items is on the meter-lamp panel. The following descriptions cover all the possible accessory items. Figure 8 shows a typical AT automatic transfer switch.

DC Charge Ammeter

The ammeter indicates the battery charge current rate of the automatic transfer switch's battery charger. Battery charging occurs only when the load is connected to commercial power.

AC Voltmeter, AC Ammeter, Frequency Meter, Running Time Meter

The voltmeter, ammeter and frequency meter indicate the voltage, amperage and frequency of the generator output. The running time meter indicates the total number of hours the generator set has operated. For three-phase operation, see *Voltmeter-Ammeter Selector Switch* for generator output voltage and ampere readings of each phase.

Voltmeter-Ammeter Selector Switch

This switch on the meter panel is normally at *OFF*. It can be turned to *1, 2 or 3* for individual readings of line currents and line-to-line voltages of generator set output.

Indicating Lamps

All automatic transfer switches have an *OVERCRANK* lamp, but only AT-E models use the lamp. It lights to indicate the generator set has failed to start.

Two battery voltage lamps used on some models indicate too high or too low battery float voltage. Lighting of the high battery voltage *(HI BAT VOLT)* lamp during normal operation indicates the charging voltage has to be reduced. The low battery voltage *(LO BAT VOLT)* lamp lights for a low voltage condition.

The green *NORMAL* lamp lights and remains lit whenever the normal power source is supplying power to the load. During a power outage, the green normal lamp goes out. After the generator set assumes the load, the red *EMERGENCY* lamp lights. It remains lit as long as the generator set carries the load.

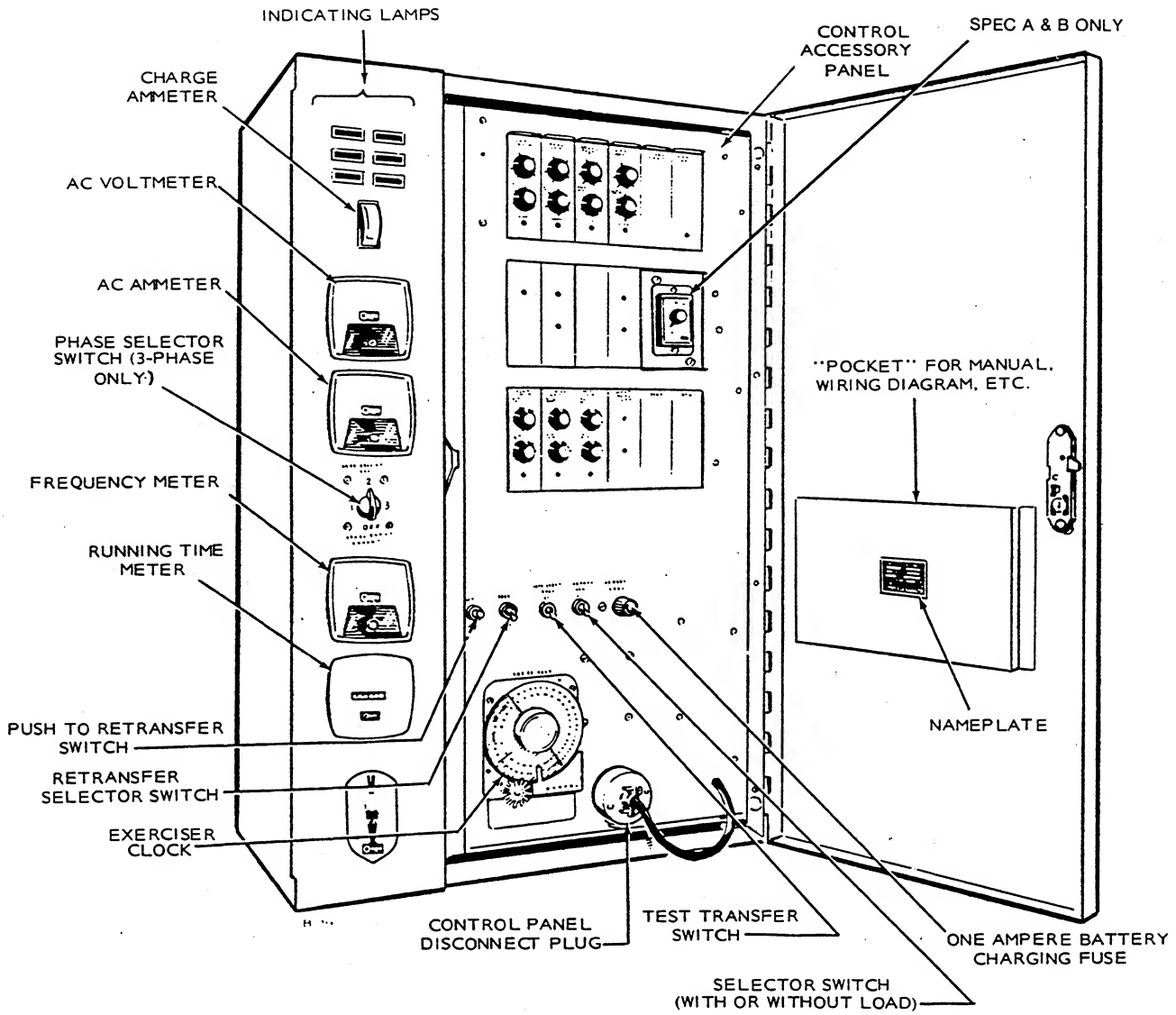


FIGURE 8. TYPICAL MODEL AUTOMATIC TRANSFER SWITCH, 30 THROUGH 225 AMPERES

CONTROL ACCESSORY PANEL

The control accessory group executes the supervisory functions of sensing, timing, logic, and others. The specific control functions are mounted on the swinging control accessory panel which is located directly behind the locking cabinet door. See Figure 8.

Series AT automatic transfer switches can be divided into two classes, those with solid-state control accessory groups (10-15 and 20-25) and those with relay control accessory groups (51-55). Figure 9 gives the relationship of the two control accessory groups.

Figure 8 shows an AT with a solid-state control, and Figure 11 shows a relay control. A description of each follows.

The control panel has provisions for opening. See the *OPERATION* section for procedures required when opening the panel.

WARNING ***High voltages within the cabinet present a serious electrical shock hazard which might cause serious personal injury or death. For this reason, do not open the control accessory panel unless required and only as outlined in this manual for those required occasions.***

Solid-State Type Control (Groups 10-15 and 20-25)

The control accessory panel has three printed circuit board racks with positions 1 through 18 for plug-in modules. They are the battery charger (if equipped), switches, battery charger fuse, voltage sensors, time delays, etc. See Figure 8.

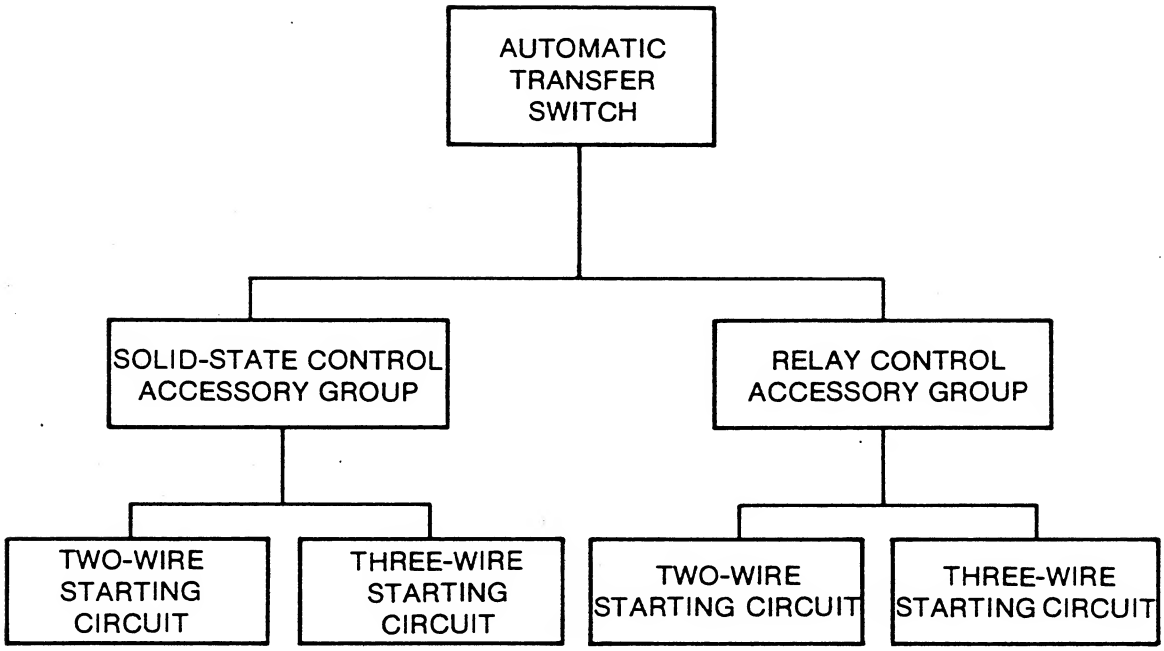


FIGURE 9. CONTROL ACCESSORY GROUPS

Starting Control: The AT is designed for operation either with Onan liquid-cooled generator sets with two-wire start control circuitry or for Onan air-cooled generator sets with three-wire start control circuitry. Note the separate descriptions of each following:

Two-Wire Starting: The operation of a two-wire starting circuit can be thought of as a simple single-pole, single-throw switch. A closed switch signals the generator set to start and run. The starting battery provides the operating voltage.

AT series automatic transfer switches include twelve and twenty-four volt models for two-wire starting. Actual generator set mode of operation is controlled by an operation selector switch on the generator set control panel.

Three-Wire Starting: This starting logic is similar to a single-pole, double-throw switch. A common is closed to one side to send a start signal. The common is closed to the opposite side to send a stop signal.

Three-wire starting AT controls have an additional module in comparison to two-wire start AT controls, a two-to-three wire converter module (Figure 10). It has an operation selector switch which controls starting and stopping of the generator set from the AT. Note the switch positions and functions which follow.

STOP—Shuts down the generator set and prevents it from starting. Use this position when servicing the generator set.

HAND CRANK—Prevents automatic generator set starting but allows starting and stopping at the generator set. Use this position for generator set maintenance.

NORMAL—Allows the generator set to start and assume the load if a power outage occurs. This is the normal operating position.

The module also has a cranking limiter, a protective circuit that limits the time the engine starter motor is engaged. If the generator set fails to start within the adjustable time limit, the cranking limiter opens the starting circuit disengaging the engine starter motor. The *OVERCRANK* indicating lamp will be lit. When the cranking limiter opens the starting circuit, the cranking limiter reset will restore the cranking limiter, after the engine starting problem has been resolved.

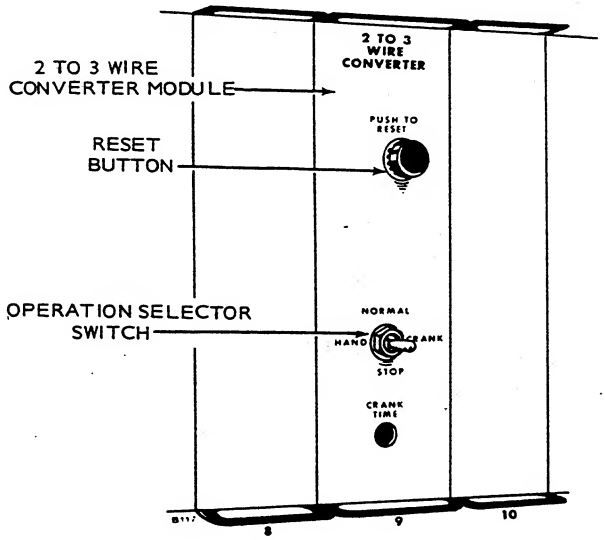


FIGURE 10. 2 TO 3 WIRE CONVERTER MODULE

AC Voltage Sensors: Voltage sensors can be used for undervoltage or overvoltage sensing on the line and undervoltage sensing for the generator power supply. Both the pickup and dropout voltages are adjustable. In undervoltage application, sensing is across the line. When line voltage falls to a dropout point, a relay de-energizes to start the generator set and transfer the load to the emergency power source. When line voltage returns to the preset pickup voltage, the relay initiates load return to commercial power.

Overvoltage is much the same, only when the normal service voltage becomes excessively high, a relay is energized to initiate load transfer to the standby generator set. When the normal power source's voltage returns to normal, the relay is de-energized and initiates load retransfer to the normal source.

The voltage sensor for the generator is connected across two generator output lines. It monitors generator voltage to disconnect the overcrank circuit on AT-E models and signals the automatic transfer switch to transfer the load to the generator set.

Table 2 gives the ranges in percentages for the adjustable voltage sensors. Adjustments should be performed by qualified personnel only.

TABLE 2. ADJUSTABLE VOLTAGE SENSORS

	UNIT STARTS (line dropout voltage)	UNIT STOPS (line pickup voltage)
Undervoltage Sensor	5% to 20% below pickup voltage setting	75% to 100% of normal voltage
Overvoltage Sensor	101% to 116% of normal voltage	5% to 20% below pickup voltage setting

Time Delays: A time delay is often required for one or more functions such as engine starting, load pickup (transfer), load transfer to the normal power source (retransfer) and engine stopping. Table 3 gives the time ranges of the adjustable time delays and the settings, if factory set.

TABLE 3. ADJUSTABLE TIME DELAYS

TIME DELAY	TIME RANGE	FACTORY SETTING (If any)
Starting	0.5 to 10 sec. 0.5 to 615 sec.*	2 sec. —
Transfer (Spec A-B)	0.5 to 10 sec.	2.5 sec.
Transfer, Retransfer (Spec C)	0.1 to 15 sec. 0.5 to 30 min.	2.5 sec. 10 min.
Stopping	0.1 to 10 min.	5.0 min.
Preheat	5 to 90 sec.	20 sec.

*Programmable start-stop timer (optional)

Time Delay on Starting: Delays generator set starting after a power outage. It prevents generator set operation during very short power outages.

Time Delay on Transfer (load pickup): Delays the transfer of the load to the generator set to allow for engine warm-up.

Time Delay on Retransfer: Allows the generator set to run for a few minutes under load before shutdown and allows time for the returning normal power source to stabilize before connecting it to the load. The generator set supplies power during this period.

Time Delay on Stopping (after retransfer): Allows the generator set to run for a few minutes under no load to cool down before shutdown. This stabilizes engine temperature, reducing distortion and wear.

Time Delay on Preheat: A time delay is available for AT-E automatic transfer switches (begin Spec B) to preheat diesel engines of 3-wire start generator sets. It delays cranking (after time delay on starting) to permit heating of the diesel engine glow plugs.

Battery Voltage Sensor: The battery voltage sensor, available in either a 12-volt or 24-volt version, is a plug-in module with two relays mounted on the printed circuit board. The battery voltage sensor module 10 monitors the battery charging system. If the battery charger is exceeding a safe voltage, it lights the high battery voltage *(HI BAT VOLT)* lamp. If the battery charger fails to charge, the sensor lights the low battery voltage *(LO BAT VOLT)* lamp.

Battery Charger: The solid state battery charger has a maximum two-ampere ouput and is voltage regulated to "float charge" the battery continuously without damage to the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery (keeping starting batteries fully charged). The battery charger can be used for either lead acid or nickel cadmium batteries.

Exerciser Clock: The exerciser clock automatically initiates starting of the generator set at regular intervals and allows it to run for preset time periods. Whether the generator set exercises with or without load depends on the position of the selector switch (at *WITH LOAD* or *WITHOUT LOAD*). If a power outage occurs while the generator set is exercising at no load, the automatic transfer switch will transfer the load to the generator set.

The exerciser will operate the generator set for any multiple of 15 minutes per day for as many days as desired. The clock has a 24-hour dial with the light half for day and the shaded half for night.

Onan recommends exercising the generator set for at least 30 minutes once each week. Running it for long periods each week is better than several short periods.

Selector Switch: This switch is set at *WITH LOAD* if the generator set is to carry the load during test or exercise periods. Set at *WITHOUT LOAD*, the generator set starts but does not assume the load.

If the selector switch is moved from *WITHOUT LOAD* to *WITH LOAD* during test, the generator set will stop, go through the start time delay, crank, run, and go through transfer time delay before assuming the load.

Test Transfer Switch: Set at *NORMAL*, the standby system is set for automatic operation (generator set starts if a power outage occurs). To simulate a power outage, the switch is moved to *TEST*. The generator set starts and runs as long as the switch remains in this position.

Retransfer Selector Switch: Positioned at *AUTO*, the load will automatically be retransferred back to commercial power from the generator set. If it is set at *MANUAL*, the load will not be transferred back to the normal line source until the push to retransfer switch is pressed.

Push to Retransfer Switch: This switch is used for installations which require the generator set to supply power until retransfer is manually initiated after normal power returns.

Relay Type Control (Groups 51-55)

Components of a relay control may include as the application requires, solid-state voltage sensing, time delay relays, control switches, battery charger, and an exerciser clock. Figure 11 shows a relay control.

Starting Control: The AT is designed for operation either with Onan liquid-cooled generator sets with two-wire start control circuitry or for Onan air-cooled generator sets with three-wire start control circuitry. Note the separate descriptions of each following:

Two-Wire Starting: The operation of a two-wire starting circuit can be thought of as a simple single-pole, single-throw switch. A closed switch signals the generator set to start and run. The starting battery provides the operating voltage.

AT series automatic transfer switches include twelve and twenty-four volt models for two-wire starting. Actual generator set mode of operation is controlled by the selector switch on the control panel. It has three positions. Note functions of positions.

NORMAL: In this position, the automatic transfer switch will respond to the interruption and return of the normal power source, automatically.

STOP: In this position, the automatic transfer switch will not respond to a normal power interruption.

TEST: This position is used to start the generator set without applying the load.

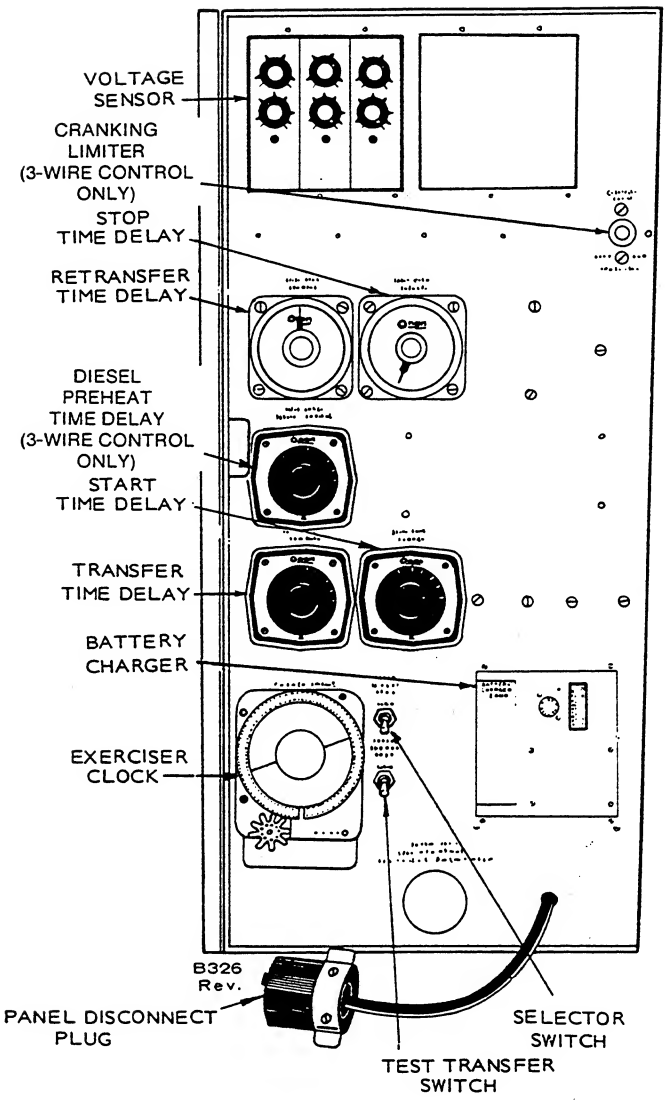


FIGURE 11. RELAY CONTROL PANEL

Three-Wire Starting: This starting logic is similar to a single-pole, double-throw switch. A common is closed to one side to send a start signal. The common is closed to the opposite side to send a stop signal.

Three-wire starting AT controls have a selector switch with four positions. Positions and functions are listed below.

NORMAL: In this position, the automatic transfer switch is set for automatic operation.

TEST: This position is used to start the generator set without applying the load.

STOP: In this position, the automatic transfer switch will not operate nor will the generator set start.

The engine starter motor can be engaged using the engine control, but the engine will not start.

OFF: In this position, the generator set can be started at the engine control but the automatic transfer switch will not operate.

Test Transfer Switch: Set at *NORMAL*, the standby system is set for automatic operation (generator set starts if a power outage occurs). To simulate a power outage, the switch is moved to *TEST*. The generator set will start, run, and assume the emergency load.

Cranking Limiter: Included on all AT-E automatic transfer switches for three-wire start generator sets is a cranking limiter. It is an electrically-operated thermal relay which protects the engine cranking circuit and remains energized until the engine starts. If the engine does not start within 45 to 90 seconds, the heating element in the relay opens the cranking circuit.

Time Delays: A time delay is often required for one or more functions such as engine starting, transfer (load pickup), retransfer (load transfer to normal power source), and engine stopping. Table 4 gives the time ranges of the adjustable time delay relays, and the settings, if factory set.

TABLE 4. ADJUSTABLE TIME DELAYS

TIME DELAY	TIME RANGE	SUGGESTED SETTING
Starting	1 to 300 sec.	1 to 3 sec.
Transfer	1 to 300 sec.	5 to 10 sec.
Retransfer	2 to 60 min.	10 min.
Stopping	2 to 60 min.	5 min.
Preheat	1 to 300 sec.	60 sec.

Time Delay on Starting: Delays generator set starting after a power outage. It prevents generator set operation during very short power outages.

Time Delay on Transfer (load pickup): Delays the transfer of the load to the generator set to allow for engine warm-up.

Time Delay on Retransfer: Allows the generator set to run a few minutes under load before shutdown and allows time for the returning normal power source to stabilize before connecting it to the load. The generator set supplies power during this period.

Time Delay on Stopping (after retransfer): Allows the generator set to run for a few minutes under no load to cool down before shutdown. This stabilizes engine temperature, reducing distortion and wear.

Time Delay on Preheat: This time delay assembly is used in AT-E series automatic transfer switches to delay cranking of three-wire starting diesel generator sets while preheating the engine glow plugs.

Exerciser Clock: The exerciser clock automatically initiates starting of the generator set at regular intervals to run for preset time periods without load. If a power outage occurs while the generator set is exercising at no load, the automatic transfer switch will transfer the load to the generator set.

The exerciser will operate the generator set for any multiple of 15 minutes per day for as many days as desired. The clock has a 24-hour dial with the light half for day and the shaded half for night.

Onan recommends exercising the generator set for at least 30 minutes once each week. Running it for long periods each week is better than several short periods.

AC Voltage Sensors: Voltage sensors can be used for undervoltage or overvoltage sensing on line side, and undervoltage sensing for generator power supply. Both the pick-up and drop-out voltages are adjustable. In undervoltage applications, sensing is across the line. When line voltage falls to a drop-out point, a relay de-energizes to start the generator set and transfer the load to the emergency power source. When line voltage returns to the preset pick-up voltage, the relay initiates load return to commercial power.

Overvoltage is much the same, only when the normal service voltage becomes excessively high, a relay is energized to initiate load transfer to the standby generator set. When the normal power source voltage returns to normal, the relay is de-energized and initates load retransfer to the normal source.

Table 5 gives the ranges in percentages for the adjustable voltage sensors. Adjustments should be performed by qualified personnel only.

TABLE 5. ADJUSTABLE VOLTAGE SENSORS

	UNIT STARTS (line drop-out voltage)	UNIT STOPS (line pick-up voltage)
Undervoltage Sensor	5% to 20% below pick-up voltage setting	75% to 100% of normal voltage
Overvoltage Sensor	101% to 116% of normal voltage	5% to 20% below pick-up voltage setting

Battery Charger: The AT has two solid-state battery chargers available. One is a two-ampere battery charger, the other is a 50- to 300-milliampere battery charger. Both have an ammeter to indicate charge rate, and both can be used with either lead-acid or cadmium batteries.

The two-ampere charger has a maximum two-amperes output and is available for 12- or 24-volt systems. It is also voltage regulated to "float charge" the battery continuously without damage to the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery (keeping starting batteries fully charged).

Available for 12-volt systems only, the 50- to 300-milliampere battery charger is used to maintain batteries once charged. It has a rheostat for adjusting the charge rate.

Operation

AUTOMATIC OPERATION

A series AT automatic transfer switch is set for automatic operation by placing the following control switches in the positions given. The generator set must also be set for automatic operation.

Solid-State, Two-Wire,
Control Accessory Groups

Test Transfer Switch - NORMAL
Retransfer Selector Switch - AUTO

Solid-State, Three-Wire,
Control Accessory Groups

Operation Selector Switch - NORMAL
Test Transfer Switch - NORMAL
Retransfer Selector Switch - AUTO

Relay, Two-Wire,
Control Accessory Groups

Operation Selector Switch - NORMAL
Test Transfer Switch - NORMAL

Relay, Three-Wire,
Control Accessory Groups

Operation Selector Switch - NORMAL
Test Transfer Switch - NORMAL

RETRANSFER, MANUALLY INITIATED

The retransfer of the load, from the emergency to the normal power source, can be delayed until initiated manually by the operator. This manually initiated retransfer operation is possible only with solid-state control accessory groups that include the retransfer selector switch. This procedure allows the operator to plan for the momentary interruption of service to the load on retransfer. The procedure is:

1. Place the retransfer selector switch in the *MANUAL* position. The automatic transfer switch will not retransfer automatically when the normal power source returns.
2. Manually initiate retransfer by pushing the push to retransfer switch.

If the emergency power source should fail while the retransfer selector switch is in the *MANUAL* position, a bypass circuit will automatically retransfer the load to the normal power source, if available.

TEST OPERATION

Solid-State Control Accessory Groups

1. Place the with or without load selector switch in the desired position.
2. Move the test transfer switch to *TEST*.
3. At end of test period, return the test transfer switch to *NORMAL*.

During test operation, switching from *WITHOUT LOAD* to *WITH LOAD* will cause the generator set to stop, go through the start time delay, start, run, and go through the transfer time delay before assuming the load.

Relay Control Accessory Groups

Test With Load:

1. Move the test transfer switch to *TEST*.
2. Return the test transfer switch to *NORMAL* at the end of test period.

Test Without Load:

1. Move the operation selector switch to *TEST*.
2. Return the operation selector switch to *NORMAL* at the end of the test period.

EXERCISE

Onan recommends running the generator set for a minimum of thirty minutes, with at least fifty percent load if possible, once each week. Automatic transfer switches with an exerciser clock can be set to start and run the generator set at selected times automatically, see *ADJUSTMENTS*. If the normal power source should be interrupted while the generator set is exercising without load, the automatic transfer switch will transfer the load.

After a power outage, reset the exerciser for correct time (exerciser operates only on normal power).

Solid-State Control Accessory Groups

1. Set the exerciser clock to start the generator set at the desired time.
2. Place the with or without load selector switch in the desired position.

Relay Control Accessory Groups

1. Set the exercisor clock to start the generator set at the desired time. The generator set will run without load.

OVERCRANK

An overcrank condition exists when the generator set has not started within the time limit set by the cranking limiter. To restore the automatic transfer switch starting circuit:

1. Correct the engine starting problem.
2. Push the cranking limiter reset.

MANUAL OPERATION

An operator can manually transfer or retransfer a series AT transfer switch using direct manpower. The transfer switch is equipped with manual operator handles for this purpose.

Before the control accessory panel can be opened for manual operation of transfer switch: (1) The operation selector switch must be moved to *STOP* (on 2 to 3 wire converter module — AT-E models; on engine control for AT-C and AT-D models), and (2) the control accessory panel disconnect plug must be removed. It removes AC line voltage from the control accessory panel for a safer procedure.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. The disconnect plug does not de-energize the transfer switch. Move the operation selector switch to STOP* before the disconnect plug is removed to prevent the generator set from starting and energizing the transfer switch.**

WARNING ***The automatic transfer switch has components with high AC voltages which might cause serious personal injury or death if touched. Do not attempt manual transfer switch operation with either normal line or generator set power connected to the automatic transfer switch. Remove AC power from the automatic transfer switch before manual operation.***

Figure 12 shows a 100- and 400-ampere transfer switch with manual operators. Use the following appropriate instructions either for 30- through 225-ampere switches or 400-ampere switches.

Manual Operation, 30 Through 225 Ampere AT's

Refer to the 100-ampere transfer switch shown in Figure 12. If the transfer switch is closed on line side, push in the lower, left red knob (C) to release the line-side mechanical latch. When you hear the contacts open, push in the upper, right black knob (B) to close the generator-side contacts.

If the transfer switch is closed on generator side, push in the lower, right red knob (D) to release the generator-side mechanical latch, then push in the upper, left black knob (A) to close the line-side contacts.

Manual Operation, 400 Ampere AT's

If the transfer switch is closed on line side, push in the lower left lever (C) to release the line-side mechanical latch. Put on the handle extension and then push up the black handle (B) on generator side of the transfer switch (Figure 12).

To transfer to line side, push in the lower right lever (D) to release the generator-side mechanical latch. When you hear the contacts open, put on the handle extension and push up the black handle (A) on line side of the transfer switch.

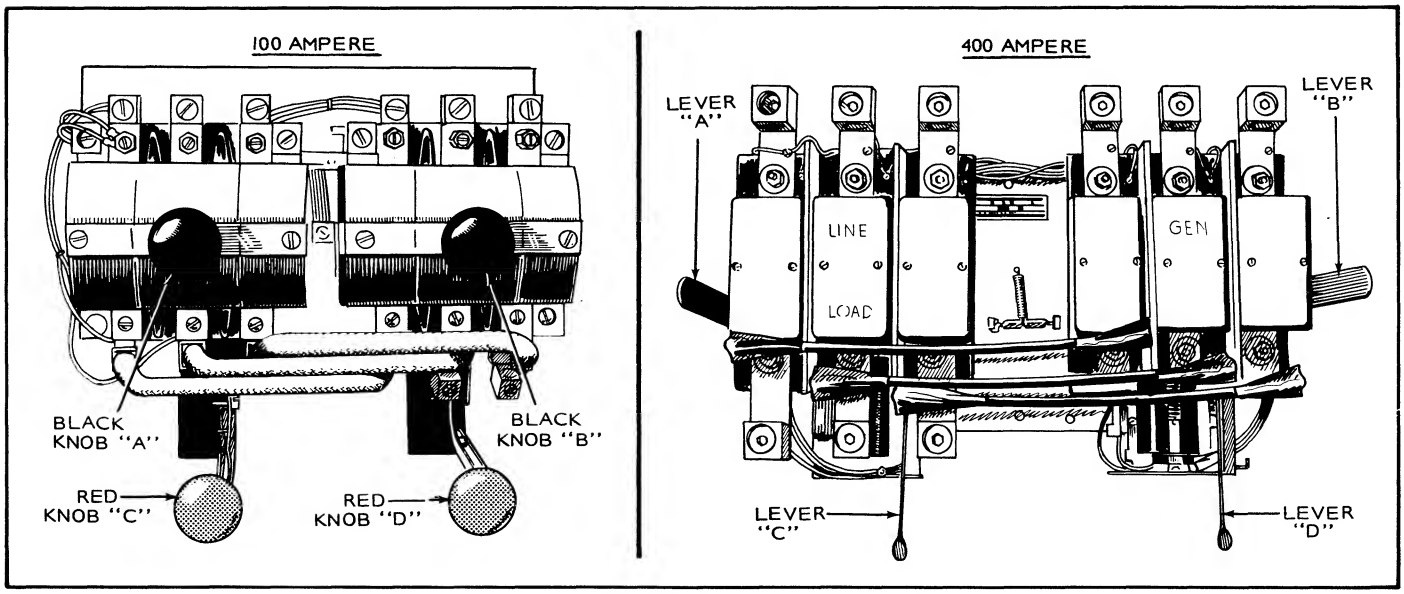


FIGURE 12. TRANSFER SWITCH MANUAL OPERATORS

Adjustments

LATCH AND LATCH PIN ADJUSTMENT

If the control accessory panel will not close because the latch is above or below the latch pin (on meter panel for 30 through 225 ampere AT's, on cabinet center support for 400 ampere AT's), perform the following.

1. Open cabinet door of automatic transfer switch.
2. Move operation selector switch to *STOP* (in cabinet for three-wire starting, on engine control for two-wire starting) and disconnect starting battery.
3. Remove AC line voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect starting battery, and remove AC line power before attempting adjustments.***

4. Remove the twist-lock disconnect plug.
5. Completely open the control accessory panel.
6. ***400 Ampere AT Only:*** Remove the one screw from the inside center support for the left cabinet door and open. Proceed to Step 8.
7. Remove the one screw on top and one screw on bottom from inside meter panel flange. Open meter panel.
8. Loosen the latch pin on the edge of the meter panel or cabinet center support, whichever applies, and move the latch pin up or down in the slot as necessary (Figure 13). Then tighten.
9. ***400 Ampere AT Only:*** Close the left cabinet door and reinstall the one screw. Proceed to Step 11.
10. Close the meter panel and reinstall the two screws removed in Step 7.
11. Close the control accessory panel. If more adjustment is necessary, repeat Steps 5 through 11.
12. Reconnect the twist-lock disconnect plug.
13. Restore AC line voltage to the automatic transfer switch.
14. Move operation selector switch to *NORMAL* (in

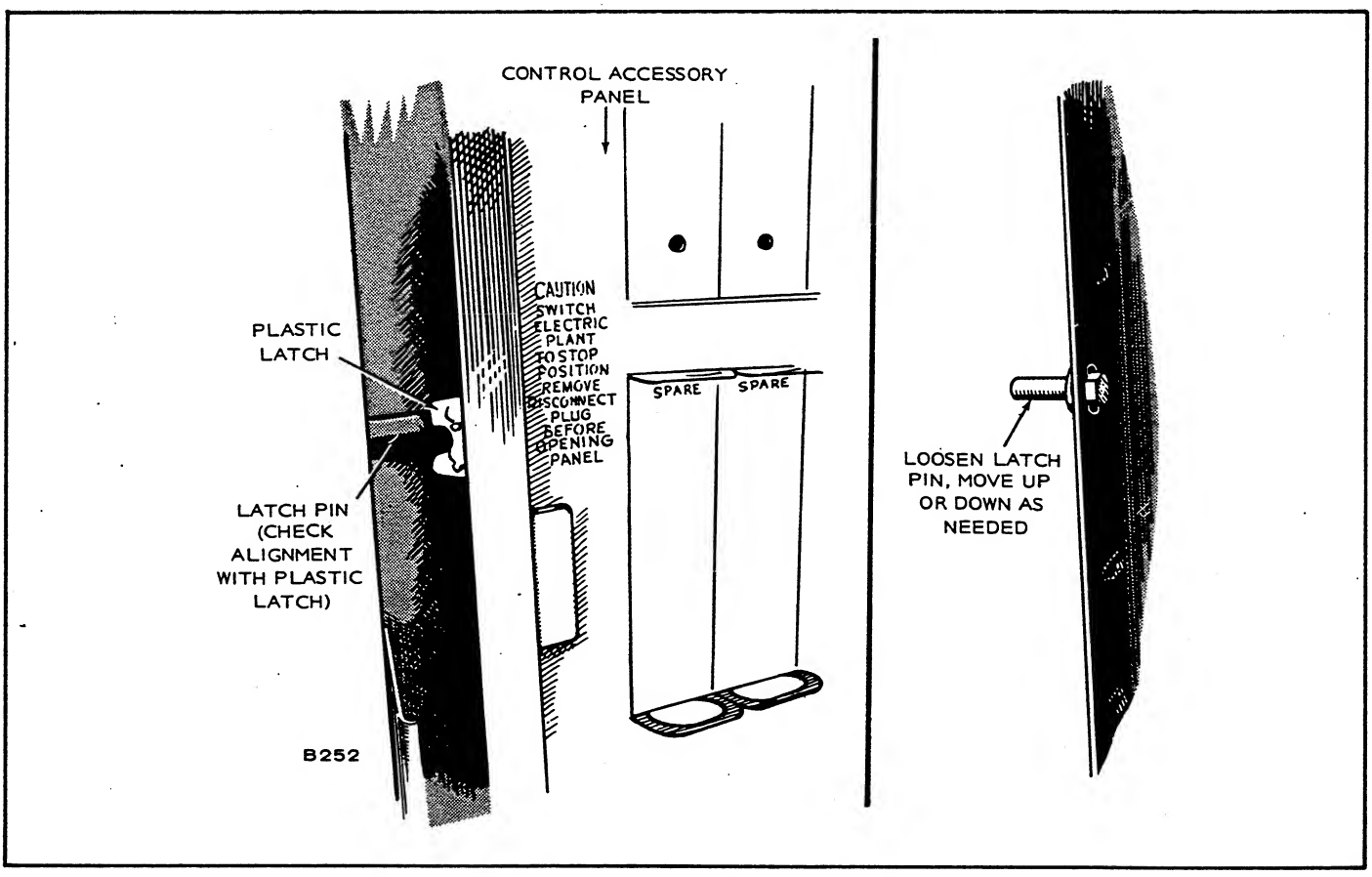


FIGURE 13. ADJUSTMENT OF LATCH PIN

cabinet for three-wire starting) or *RMT* (on engine control for two-wire starting), whichever applies.

15. Reconnect starting battery.
16. Close cabinet door.

EXERCISER CLOCK

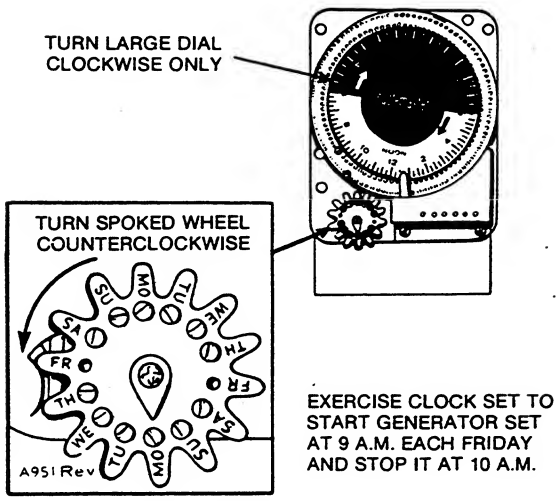
1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch (on engine control for two-wire starting, in cabinet for three-wire starting) to *STOP*.
3. Install a trip pin **(left-hand thread)** in the inside row of holes on the large dial for the time of day you want the generator set to start. See Figure 14.
4. Place a trip pin **(left-hand thread)** in the outside row of holes on the large dial to stop the generator set.

   Onan recommends settings which operate the generator set for at least 30 minutes each week. Exercising for one long period is better than several short periods.

5. Install a trip pin **(left-hand thread)** in the small spoked wheel for every day *no exercise* is desired.
6. Rotate the large dial **(clockwise)** until the correct time is correctly aligned with the time pointer.
7. Turn the small spoked wheel **(counterclockwise)** until the correct day aligns with the pointer.

   Sixteen trip pins are supplied with the clock. Store unused pins on the time pointer bracket.

8. Move the operation selector switch to *RMT* (two-wire starting) or *NORMAL* (three-wire starting) whichever applies.
9. Close the cabinet door.



NOTE: Trip pins are left-hand thread.

FIGURE 14. EXERCISER CLOCK

TIME DELAYS

For adjustments of the programmed transition time delay assembly, see the following instructions. For the other time delays, follow instructions under *Control Accessory Groups 10 Through 15 and 21 Through 25* for the modular-type panel, *Control Accessory Groups 50 Through 55* for the relay-type panels.

Programmed Transition Time Delay

You can use the programmed transition time delay to provide 1 to 300 seconds of no power to loads during either transfer or retransfer of transfer switch operation. For adjustment, use the following procedure:

1. Open cabinet door of automatic transfer switch.
2. Move the operation selector switch to *STOP* (on control accessory panel in cabinet for three-wire starting, on engine control for two-wire starting) and disconnect starting battery.
3. Remove AC line power to the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect starting battery, and remove AC line power before attempting adjustments.***

4. ***400 Ampere AT Only:*** Remove the one screw from the inside center support for the left cabinet door and open.
5. Remove the two screws from the meter-lamp panel's inside flange and open meter-lamp panel.
6. Locate the programmed transition assembly below the transfer switch on rear panel of cabinet. Transfer time delay K11 (for line side) is located on the left, time delay K12 (for generator side) is on the right.
7. Turn the knob (on the time delay to be adjusted) clockwise to increase delay (increments marked on knob), counterclockwise to decrease time delay.
8. Close the meter-lamp panel and secure with two screws.
9. ***400 Ampere AT Only:*** Close the left door and secure with screw to cabinet center support.
10. Restore AC line voltage to automatic transfer switch.
11. Move the operation selector switch to *NORMAL* (in cabinet for three-wire starting) or *RMT* (on engine control for two-wire starting), whichever applies.
12. Reconnect starting battery.

Control Accessory Groups 10 Through 15 and 20 Through 25

Start-Stop Time Delay: Time delay for start is factory adjusted for 2 seconds. Time delay on stop is factory adjusted for 5 minutes. If other times are desired, use the following procedure:

1. Open the cabinet door of automatic transfer switch.
2. Move selector switch to *WITH LOAD*.
3. Move test transfer switch to *TEST*.
4. With a stopwatch or watch with a second hand, measure the time until the generator set starts cranking.
5. Insert a small screwdriver through *START* hole in front panel of start-stop time delay module 7. Turn *START* potentiometer clockwise to increase start time delay or counterclockwise to decrease start time delay. Make adjustments in small increments.
6. Move test transfer switch to *NORMAL*.
7. Measure time until generator set begins to shut down.
8. Turn *STOP* potentiometer with the small screwdriver clockwise to increase the stop time delay or counterclockwise to decrease the stop time delay. Make adjustments in small increments.
9. Repeat steps 2 through 8 until desired delay times are obtained.
10. Move selector switch to desired position, *WITHOUT LOAD* or *WITH LOAD*.

Optional Start-Stop Time Delay: A programmable start-stop modular time delay is available for increasing the time span of the start-stop time delay. Table 6 lists switch settings and delay times.

TABLE 6. PROGRAMMABLE TIME DELAY

PROGRAMMABLE START — STOP TIMER

c = SWITCH CLOSED
o = SWITCH OPEN

SWITCH POSITIONS				
1	2	3	4	TO START
5	6	7	8	TO STOP
				TIME
o	o	c	o	0.5 sec
o	o	o	c	1.0 sec
c	o	c	o	1.4 sec
c	c	c	o	2.4 sec
c	o	o	c	5.5 sec
o	o	o	o	7.9 sec
c	c	o	c	9.6 sec
c	o	o	o	43 sec
o	o	c	c	62 sec
c	c	o	o	76 sec
c	o	c	c	345 sec
c	c	c	c	615 sec

TIME TOL ± 20%

This module is for use on Control Accessory Groups 10 through 15 and 20 through 25. Figure 15 illustrates start-stop delay module.

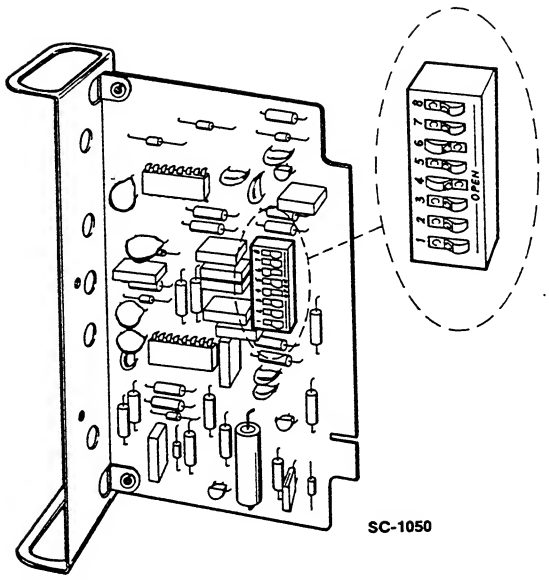


FIGURE 15. OPTIONAL START-STOP TIME DELAY (SPEC C)

Transfer-Retransfer Time Delay Module (Spec C): For adjustment or change of the time delay for transfer (of load to generator set) from standard setting, two or three seconds; or time delay for retransfer (transfer of load to normal power) from the standard setting, 10 minutes, follow this procedure.

1. Open cabinet door of automatic transfer switch.
2. Move the selector switch to *WITH LOAD*.
3. Move test transfer switch to *TEST*. The generator set will start and run.
4. With a stopwatch or watch with a second hand, measure the time the upper light on the transfer-retransfer time delay module 8 remains red. If the time delay is correct or time you desire, proceed to Step 6. If not, proceed to Step 5.
5. Insert a small screwdriver through the *TRANSFER* hole (upper hole) in the front panel of the transfer-retransfer time delay module. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease time delay.
6. Move the test transfer switch to *NORMAL*.
7. With a stopwatch or watch with a second hand, count the number of flashes the bottom green light makes in 60 seconds (Onan suggests counting for 60 seconds — shorter intervals would give less accuracy for determining time delays). Once retransfer timing is complete, the red retransfer light will turn off, and the green light will remain on for the duration of the stop delay. See the following for correlating pulses to time delays.

Pulses/60 sec.	Time Delay (min.)
50	5
25	10
17	15
13	20
10	25
8	30

If time delay is correct or time you want, proceed to Step 10. Otherwise, proceed to Step 8.

8. Insert a small screwdriver through the *RE-TRANSFER* hole (lower hole) in the front panel of the transfer-retransfer time delay module. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease the time delay.
9. Repeat Steps 3 through 8 until the desired time delays are obtained.
10. Move the selector switch to *WITH LOAD* if you want the generator set to assume load during exercise or tests.
11. Close the cabinet door.

Transfer Time Delay (Spec A and B): For adjustment or change of the time delay for transfer (transfer of the load to the generator set) from the standard setting, 2.5 seconds, use the following procedure:

1. Open cabinet door of automatic transfer switch.
2. Move operation selector switch to *STOP* (on engine control for two-wire starting, in cabinet for three-wire starting).
3. Move selector switch to *WITH LOAD*.
4. Remove the twist-lock disconnect plug.
5. Open the control accessory panel.
6. Locate generator interposing relay K4 (Figure 16).
7. Reconnect the twist-lock disconnect plug with the control accessory panel open.

WARNING ***Rear of the control accessory panel is now energized and presents a shock hazard which can cause serious personal injury or death. Use extreme care not to touch rear of control accessory panel.***

8. Move operation selector switch to *RMT* (two-wire starting) or *NORMAL* (three-wire starting), whichever applies.

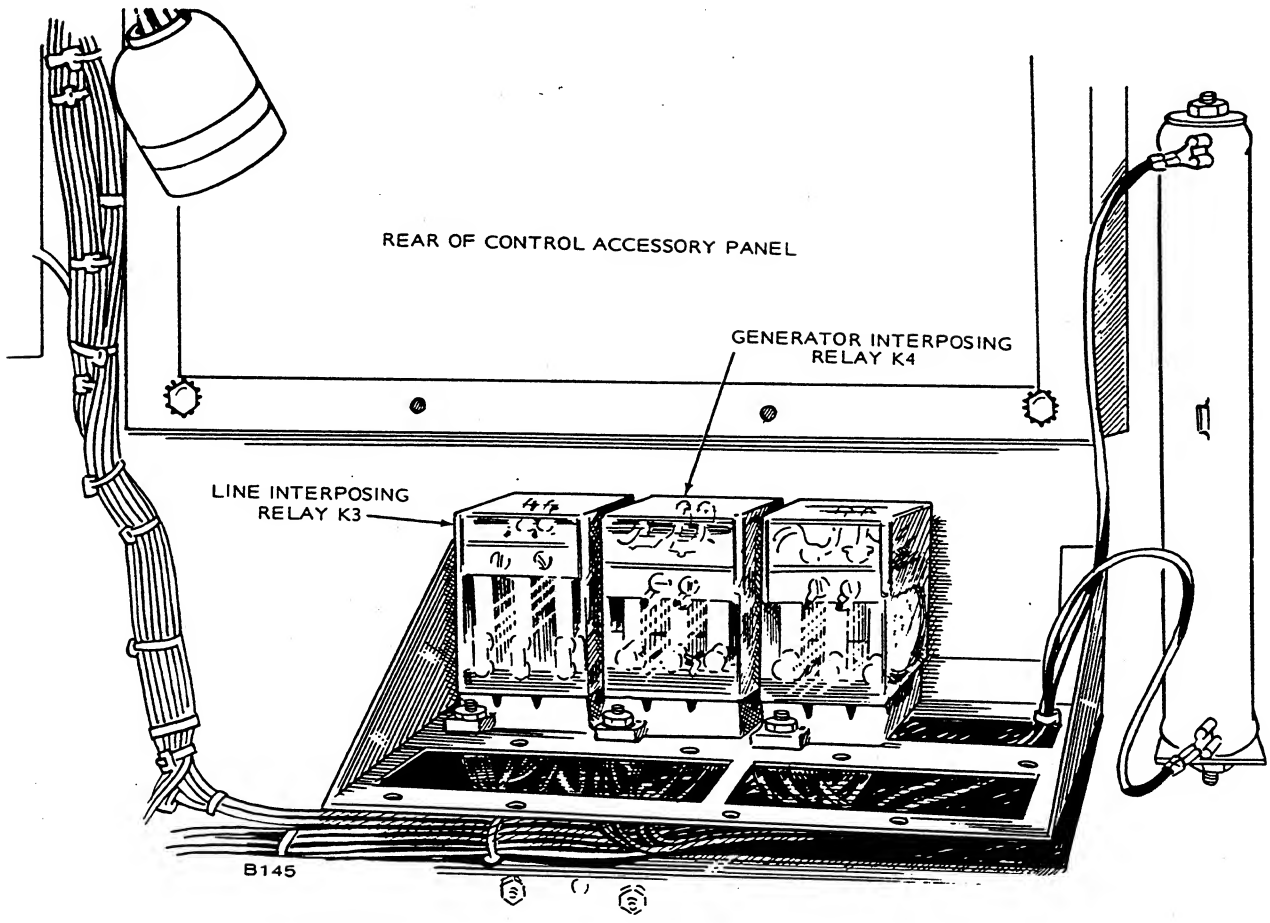


FIGURE 16. LOCATION OF INTERPOSING RELAYS

9. Move test transfer switch to *TEST*. Generator set will start and run.
10. With a stopwatch or watch with a second hand, measure time from instant generator set reaches full speed until relay K4 contacts close. If time delay is correct or time you desire, proceed to Step 14. If not, proceed to Step 11.
11. Insert a small screwdriver through hole in front panel of transfer time delay module 8. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease the time delay.
12. Move the test transfer switch to *NORMAL* to stop the generator set.
13. Repeat Steps 9 through 12 until the desired time delay is obtained.
14. Move the test transfer switch to *NORMAL*.
15. Move operation selector switch to *STOP*.
16. Remove the disconnect plug and close the control accessory panel.
17. Reconnect the disconnect plug.
18. Move the operation selector switch to *RMT* (two-wire starting) or to *NORMAL* (three-wire starting), whichever applies.
19. Return selector switch to desired position, *WITHOUT LOAD* or *WITH LOAD*.
20. Close cabinet door.

Retransfer Time Delay: (Spec A and B): Automatic transfer switches (series AT) with one of the two retransfer time delays in Figure 17 provide 0 to 30 minutes time delay on the retransfer (retransfer of load to commercial power line). Use the following adjustments.

The one retransfer time delay shown on the left in Figure 17 has two lamps *(POWER ON* and *TIMING)* and a time adjustment knob. To set the delay, turn the adjustment knob clockwise to the desired retransfer delay time.

Shown on the right in Figure 17 is the other retransfer time delay. It has one lamp *(TIMING)* and a time adjustment knob. The adjustment knob has a black pointer and a red time-remaining indicator pointer. Turn the adjustment knob clockwise until the black pointer aligns with the desired time delay.

Preheat Time Delay: The preheat time delay (module 16) for diesel generator sets with three-wire starting is adjustable from 5 to 60 seconds. To change the delay, follow these instructions:

1. Open the cabinet door of the automatic transfer switch.
2. Move the selector switch to *WITHOUT LOAD*.
3. Move the test transfer switch to *TEST*.
4. With a stopwatch or watch with a second hand, measure the amount of time the small lamp on module 16 (preheat time delay module) lights before engine cranks.

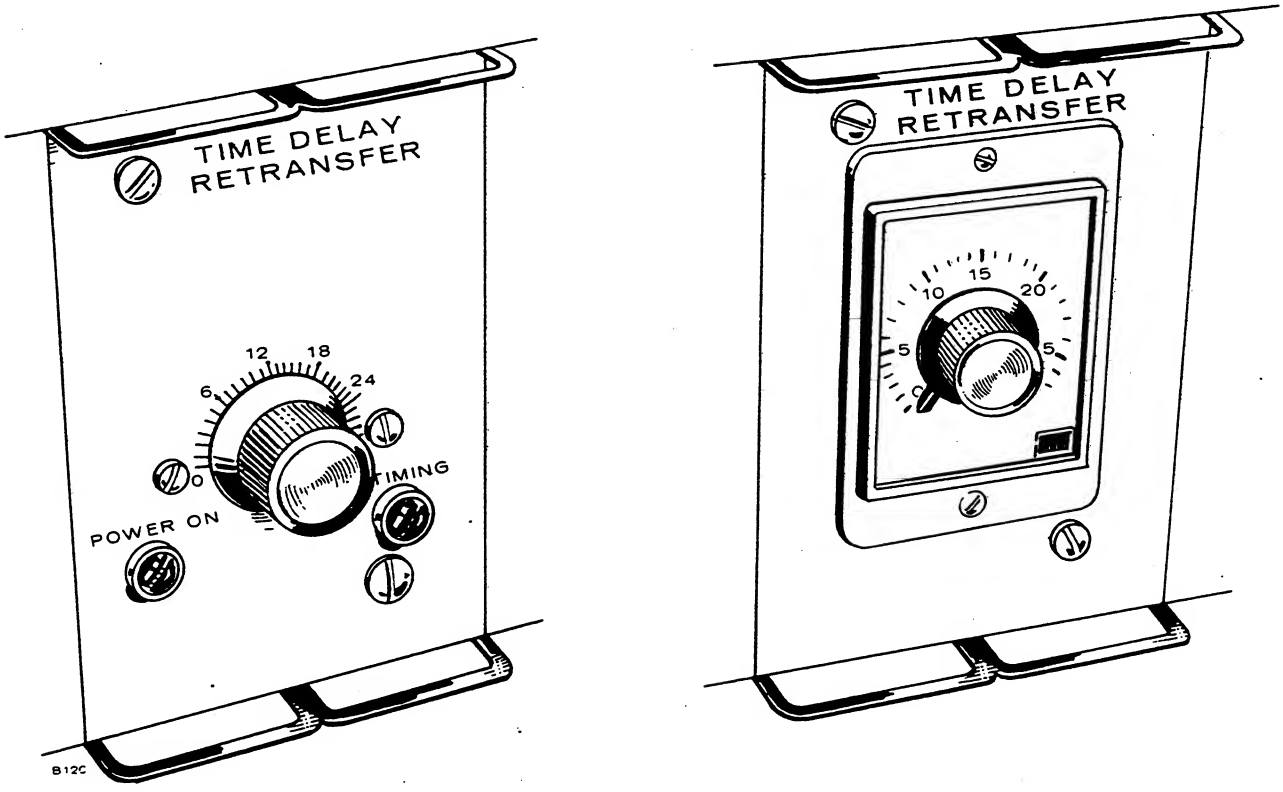


FIGURE 17. RETRANSFER TIME DELAYS

5. Move the test transfer switch back to *NORMAL*.
6. If time delay for preheat is set as desired, proceed to Step 9. If a different time is desired, proceed to Step 7.
7. Insert a small screwdriver through the *PREHEAT* hole in the front panel of preheat time delay module 16. Turn potentiometer clockwise to decrease delay. Make adjustments in small increments.
8. Repeat Steps 3 through 7 until desired preheat time is obtained.
9. Move selector switch to desired position, *WITHOUT LOAD* or *WITH LOAD*.
10. Close cabinet door of automatic transfer switch.

Control Accessory Groups 51 Through 55

Start, Transfer, and Preheat Time Delays: All of these time delays require the same adjustment procedures. Settings can range from 1 to 300 seconds (*OPERATION* section lists suggested settings). To make settings, perform the following:

1. Open the cabinet door of the automatic transfer switch.
2. Turn the knob on the time delay clockwise to increase delay time, counterclockwise to decrease the delay time. See Figure 18.
3. Close the cabinet door.

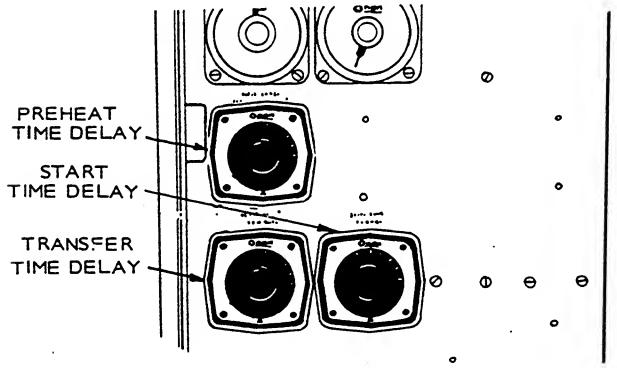


FIGURE 18. START AND TRANSFER TIME DELAY RELAYS

Stop and Retransfer Time Delays: Both of these synchronous motor-driven time delays require the same adjustment procedure. Settings can range from 2 to 60 minutes (*OPERATION* section lists suggested settings). To make settings, perform the following:

1. Open the cabinet door of the automatic transfer switch.
2. Set the time delay by turning the adjustment knob in the center of the delay. See Figure 19.

   The black pointer on the face of the time delay indicates the preset delay. The red pointer indicates the delay time left in operation.
3. Close the cabinet door.

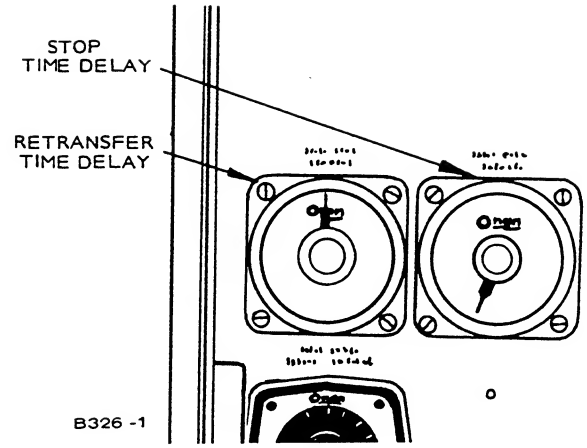


FIGURE 19. STOP AND RETRANSFER TIME DELAY RELAYS

OVERCRANK TIME (THREE-WIRE STARTING ONLY)

The following adjustment applies only to control accessory groups 10 through 15 and 20 through 25.

Overcrank settings are made at the factory for approximately 75 ±10 seconds cranking. To adjust, perform the following:

1. Remove the positive lead from the generator set's start solenoid or starter.
2. Open cabinet door of automatic transfer switch.
3. Move selector switch to *WITHOUT LOAD.*
4. Move 2 to 3 wire converter module 9 selector switch to *NORMAL.*
5. Move test transfer switch to *TEST.* Overcrank lamp on automatic transfer switch should light at end of crank period. Measure the crank time with a stopwatch or watch with a second hand.
6. To change the time, insert a small screwdriver through the *CRANK TIME* hole in the front of the 2 to 3 wire converter module. Turn clockwise to increase the cranking time or counterclockwise to decrease the cranking time. Make adjustments in small increments.
7. Move test transfer switch to *NORMAL.*
8. Push the *PUSH TO RESET* button on the 2 to 3 wire converter module.
9. Repeat Steps 5 through 8 until the desired cranking time is obtained.
10. Move selector switch to desired position, *WITHOUT LOAD* or *WITH LOAD.*
11. Close cabinet door.
12. Reconnect positive lead to generator set's starter or start solenoid.

BATTERY CHARGE RATE

Two types of battery chargers are available for AT automatic transfer switches. One is a two-ampere battery charger and the other is a 50- to 300-milliampere charger. See the correct procedure for the battery charger involved (50- to 300-milliampere charger has adjustment knob on its front panel).

Two-Ampere Battery Charger

For the following adjustments, a fully-charged battery, a hydrometer and an accurate voltmeter (1/2 percent accuracy) are needed. Onan recommends float voltages of: 13.3 volts for nominal 12-volt or 26.6 volts for nominal 24-volt lead-acid batteries; 13.8 to 14.5 volts for 10-cell nickel-cadmium batteries, or 27.6 to 29.0 volts for 20-cell nickel-cadmium batteries.

During the first few weeks of operation, the batteries should be checked periodically with a hydrometer. A high specific gravity, bubbling of electrolyte and loss of water indicate excessive float voltage. A drop in specific gravity indicates insufficient float voltage.

1. Connect the fully-charged battery (verify charge condition with the hydrometer).
2. Connect the voltmeter directly to the battery terminals.
3. Measure the battery voltage. If voltage is above the recommended float voltage, proceed to Step 4. If the voltage is below the recommended float voltage, proceed to Step 6.
4. Insert a small screwdriver through the hole in the front panel of battery charger module 6. Turn counterclockwise in small increments to decrease the float voltage.
5. After five minutes, measure the battery terminal voltage again. If voltage is still high, repeat Steps 4 and 5 until voltage stabilizes at the recommended float voltage. Proceed to Step 9.
6. Note charge current rate on charge ammeter on meter-lamp panel.
7. Insert a small screwdriver through hole in front panel of battery charger module 6. Turn clockwise in small increments to increase float voltage. Note increase in the charging current on the charge ammeter on the meter-lamp panel.
8. In approximately one hour or when charge current has decreased to initial value noted in Step 6, recheck battery terminal voltage. Repeat Steps 6 through 8 until the battery terminal voltage stabilizes at the recommended float voltage.
9. Check the battery with a hydrometer and check the battery terminal voltage periodically during the first few weeks of operation. Readjust the float charge rate if necessary.

50- to 300-Milliampere Battery Charger

Set the battery charger to maintain the batteries at full charge. This can best be done by setting the battery charger and checking the battery condition for several weeks with a hydrometer. Adjust the charger for the minimum charge rate that will maintain charge condition. Higher rates will shorten battery life. Large ambient temperature changes will probably require charger adjustment. Battery condition should be checked with a hydrometer.

AC VOLTAGE SENSORS

Voltage sensors can be used for either undervoltage or overvoltage sensing on line side, or undervoltage sensing on generator side. Range of the settings is from 90 to 140 volts for a nominal 120-volt system. For higher voltage systems, the *PICK-UP VOLTAGE* knob readings are multiplied by the following multiplying factors.

VOLTAGE	MULTIPLYING FACTOR
120	1.0
208	1.73
240	2.0
480	4.0
600	5.0

Undervoltage Sensor Settings

Use the following steps for setting undervoltage sensors. Your settings, however, might vary considerably from the example shown due to your particular application requirements. Use settings which give load protection and yet will avoid "nuisance" load transfers.

1. Open the cabinet door.
2. Move the operation selector switch to *STOP*, on engine control for two-wire starting, or in cabinet for three-wire starting.
3. Turn the *PICK-UP VOLTAGE* knob (Figure 20) to the desired pick-up voltage, voltage at which load is transferred from the generator set to the normal power source. A setting of 108 volts, for example, gives a pick-up voltage which is 90 percent of the nominal voltage for a 120-volt system.
4. Turn the % *DROP-OUT DIFFERENTIAL* knob to the desired percent deviation below the pick-up voltage. This setting determines the voltage at which load is transferred from the normal power source to the generator set. A setting of 15 percent, for example, would give a 16-volt differential from 108 volts (pick-up voltage from Step 3). Drop-out voltage is then pick-up voltage minus the differential voltage, 108 - 16 = 92 volts.
5. Move the operation selector switch on the engine control to *REMOTE* for two-wire starting or to *NORMAL* for three-wire starting, whichever applies.
6. Close the cabinet door.

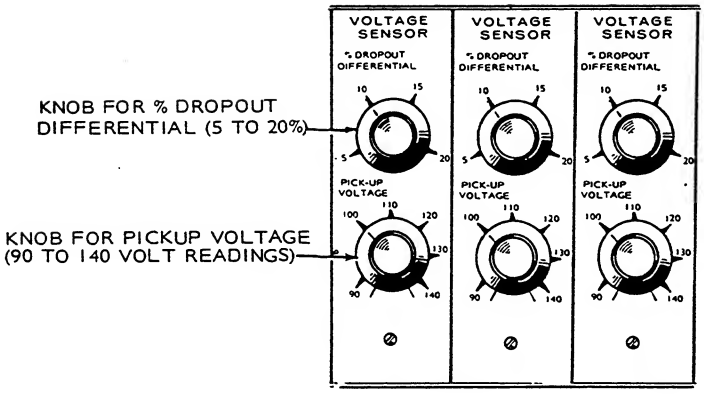


FIGURE 20. VOLTAGE SENSORS

Overvoltage Sensor Settings

Use the following steps for setting overvoltage sensors. Your settings, however, might vary considerably from the example shown due to your particular application requirements. Use settings which give load protection and yet will avoid "nuisance" load transfers.

1. Open the cabinet door.
2. Move the operation selector switch to *STOP*, on engine control for two-wiring starting, or in cabinet for three-wire starting.
3. Turn the *PICK-UP VOLTAGE* knob (Figure 20) to the desired pick-up voltage, voltage at which load is transferred from the normal power source to the generator set. A setting of 135 volts, for example, gives a pick-up voltage which is 113 percent of the nominal voltage for a 120-volt system.
4. Turn the *DROP-OUT DIFFERENTIAL* knob to the desired percent deviation below the pick-up voltage. This setting determines the voltage at which load is transferred from the generator set to the normal power source. A setting of 5 percent, for example, would give a 7-volt differential from 135 volts (pick-up voltage from Step 3). Drop-out voltage is then 135 - 7 = 128 volts.
5. Move the operation selector switch on the engine control to *REMOTE* for two-wire starting, or to *NORMAL* for three-wire starting, whichever applies.
6. Close the cabinet door.

Troubleshooting

POWER OUTAGE OCCURS, BUT GENERATOR SET DOES NOT START

1. Check for overcrank condition.
2. AT-C and AT-D only: Check position of operation selector switch on engine. Should be at *RMT.*
3. Check position of selector switch in cabinet. Should be at *NORMAL.*
4. Check generator set. Start with start-stop switch on generator set. If it does not crank, check starting batteries. If it cranks but does not start, check fuel supply.

GENERATOR SET STARTS DURING NORMAL SERVICE

1. AT-C and AT-D only: Check position of operation selector switch on engine control. Should be at *RMT.*
2. Check position of selector switch in cabinet. Should be at *NORMAL.*
3. Check if exerciser clock is turned to exercise period.
4. Check to see if control panel disconnect plug is inserted into receptacle.
5. Check voltage sensor settings (if equipped). If settings are okay, starting may be due to momentary voltage dips. Pick-up voltage settings may have to be reduced.

GENERATOR SET DOES NOT EXERCISE

1. AT-C and AT-D only: Check position of operation selector switch on engine control. Should be at *RMT.*
2. Check position of selector switch in cabinet. Should be at *NORMAL.*
3. Check exerciser clock to see if it is set correctly and running.
4. Check generator set. Start with start-stop switch on generator set. If it does not crank, check starting batteries. If it cranks but does not start, check fuel supply.

GENERATOR SET STARTS BUT DOES NOT ASSUME LOAD

1. Check output voltage of the generator set.
2. Check generator-side undervoltage sensor (if equipped) pick-up voltage setting. Setting in most cases should be at 100 volts (200 for 240-volt systems).

NO TRANSFER OF LOAD TO COMMERCIAL POWER FROM GENERATOR SET

1. Check disconnect plug in control accessory panel. Must be connected into receptacle.
2. Check retransfer time delay (if used) to see if time delay is still operating. See *OPERATION* section.
3. If automatic transfer switch has battery charging feature, check battery charging fuse. Replace if necessary with correct fuse.
4. Manually initiate retransfer by operating retransfer selector switch and push to retransfer switch (if equipped).

5. Check line voltage to make sure it is above setting of voltage sensor (if equipped).
6. Stop generator set with start-stop switch. When generator set stops, the transfer switch will transfer the load to the normal power line if voltage is normal.

GENERATOR SET CONTINUES TO RUN AFTER RETRANSFER OF LOAD TO COMMERCIAL POWER

Start-stop time delay may be defective. Stop generator set with start-stop switch.

BATTERY CHARGER FAILS TO CHARGE

Check battery charger fuse F1 in control accessory panel (if equipped with charger). Replace if necessary with correct fuse.

BATTERY LOSES EXCESS WATER

Battery charge rate may be too high (if equipped with charger). See *ADJUSTMENTS* section.

BATTERY LOSES CHARGE

Charge rate may be set too low (if equipped with charger). See *ADJUSTMENTS* section.

Parts and Service Information

This automatic transfer switch is custom engineered and specially constructed. Optional equipment and special requirements demand particular circuits and components to perform the automatic functions. Because of the individuality of each automatic transfer switch, contact the dealer from whom you purchased this equipment for service and parts. Remember to give the complete model and serial number when requesting service or parts information. The wiring diagrams furnished with your automatic transfer switch should be kept with your instruction manual in the "pocket" inside the cabinet.

Any shipments made are complete unless the packing list indicates items are backordered. Shipments are properly packed and in good order when delivered to the transportation company. Any claim for loss or damage in transit should be filed promptly against the transportation company making the delivery.

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